United States Department of Agriculture

Final Environmental Impact Statement for Revision of the Inyo National Forest Land Management Plan

Volume 1: Chapters 1 through 4, Glossary, References, and Index

Forest Service Pacific Southwest Region R5-MB-304-A August 2018

Cover Photo: Fall colors of an aspen stand at North Lake, Inyo National Forest. Photo by L. Murphy

Final Environmental Impact Statement for Revision of the Inyo National Forest Land Management Plan

Inyo, Mono, Madera, Fresno and Tulare Counties, California, and Esmeralda and Mineral Counties, Nevada

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Date Objections Must Be Received:	Within 60 days following publication of the legal notice in the newspaper of record, The Inyo Register. Objectors should check the Inyo Register and the Inyo National Forest's land management planning webpage for the legal notice publication date. It is the objector's responsibility to calculate the end of the 60-day objection filing period to ensure timely submission. See the cover letter and the Inyo National Forest's land management planning webpage for more information on the objection process and requirements.

Abstract

This final environmental impact statement documents the analysis of five alternatives (A through D, including B-modified) developed by the Forest Service to revise the land and resource management plan, as amended, for the Inyo National Forest (1988). The revised land management plan would provide for the programmatic management of approximately 2 million acres administered by the Inyo National Forest. The alternatives are described in more detail in chapter 2. Alternative A is the no-action alternative, and would keep in place the management direction from the Inyo National Forest's land and resource management plan, as amended. Alternative B-modified is a modified version of the draft revised plan (alternative B) and it is the preferred alternative.

Alternatives B, B-modified, C, and D address three revision topics that reflect the purpose and needs for the revised plan: (1) to reduce the risk of large high-intensity wildfires to communities and assets; increase the ability to manage wildfires to meet resource objectives; and reduce smoke impacts to communities; (2) to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought and climate; restore wildlife and plant habitat and diversity; and reduce the risk of wildfire impacts to species and wildlife habitat; and (3) to provide sustainable and diverse recreation opportunities that consider population demographic characteristics; reflect desires of local communities, avoid overcrowding and use conflicts, and minimize resource damage; and protect cultural resources. In addition, three areas identified as a need for change in the notice of intent are addressed but plan direction does not change between alternatives: (1) to incorporate plan direction for lands transferred to the Inyo National Forest under the National Forest and Public Lands of Nevada Enhancement Act; (2) to address benefits to people and communities; and (3) to address tribal relations and uses. These areas are incorporated in various ways throughout the alternatives.

Alternatives B through D address new information and concerns that emerged during the implementation of the current forest plan. Each alternative complies with Federal laws, regulations, and policies. These alternatives also address significant issues (unresolved conflicts with the proposed action) that were identified from comments received during our public engagement sessions and the formal 30-day scoping period.

The Forest Service will use the pre-decisional administrative review process, also referred to as the "objection process" [1] described in the 2012 Planning Rule (36 CFR 219, subpart B). This process gives an individual or entity an opportunity for an independent Forest Service review and resolution of issues before a final plan is approved. Subpart B identifies who may file objections to a plan revision, the responsibilities of the participants in an objection, and the procedures that apply to the review of the objection. Section 219.53 of the Planning Rule describes who may file an objection. Individuals and entities who have submitted substantive formal comments related to this plan revision during the opportunities for public comment for this decision may file an objection.

[1] National Forest System Land and Resource Management Planning: Final Rule and Record of Decision. Federal Register Vol. No. 77, April 9, 2012, pages 21161-21276. Available online at: https://federalregister.gov/a/2012-7502

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Preface

This final environmental impact statement and supporting documents (the planning record of the environmental analysis) are on file at the Supervisor's Office of the Inyo National Forest and at the Pacific Southwest Regional Office of the Forest Service in Vallejo, CA. Electronic copies of this document and other planning documents are available on the website for the Inyo National Forest plan revision.[2] This final environmental impact statement is organized as follows:

Volume 1

Chapter 1. Purpose of and Need for Revising the Inyo Land Management Plan. This section discusses the background of the proposal, explains the purpose of and need for revising the land management plan (also referred to as "forest plan"), and briefly describes the action proposed to satisfy the purpose and need. It summarizes public participation in the environmental review process and lists preliminary environmental and social issues identified during the scoping period.[3]

Chapter 2. Alternatives, Including the Proposed Action. This section discusses the proposed action (revised forest plan), no action, and a range of reasonable alternatives. It also explains why other alternatives were dismissed from further consideration. It includes a summary comparison of the environmental impacts of the proposal and the alternatives in comparative form, sharply defines the issues and provides a clear basis for choice among options by the decisionmaker and the public.

Chapter 3. Affected Environment and Environmental Consequences. This section documents the environmental consequences of implementing the proposed action and alternatives. It describes the affected environment for each subject of analysis as a baseline against which the impacts of alternatives are measured. The description of the environment is followed by disclosure of the potential direct, indirect, and cumulative effects of implementing the proposed action and each of the alternatives.

Chapter 4. Consultation and Coordination. This section lists the credentials of those who prepared this environmental impact statement and identifies the agencies, government officials, and selected other parties who were consulted regarding the proposed action.

Glossary. This section provides a glossary of terminology.

References. This section reports full citations for the sources cited in the text.

Index. This section provides page numbers for various topics related to the analysis

Volume 2 - Appendix

This volume contains evaluations of timber suitability (appendix A), wilderness (appendix B), and wild and scenic rivers (appendix C), range management (appendix D), consistency with other planning efforts (appendix E), species of conservation concern persistence analysis (appendix F), and the aquatic and riparian strategy (appendix G).

[2] http://www.fs.usda.gov/detail/r5/landmanagement/planning/?cid=stelprdb5444003

[3] The time during which a proposed action has been provided to the public for review and comment so that the scope of issues related to the proposed action can be determined.

Volume 3 – Response to Comments

This volume contains comments received on the draft documents (environmental impact statement and plan) and responses to those comments.

Volume 4 - Maps

This volume contains maps of the different alternatives as they relate to each resource analyzed. The maps follow the order of the various analysis sections in chapter 3.

Chapter 1.
Purpose of and Need for Revising the Inyo National Forest Land Management Plan

Introduction

We, the U.S. Department of Agriculture, Forest Service, are proposing to revise the land and resource management plan (or "forest plan"), as amended, for the Inyo National Forest. We have prepared this environmental impact statement in compliance with the National Environmental Policy Act and its implementing regulations. This environmental impact statement discloses the potential effects of a proposed revision of the Inyo National Forest Land and Resource Management Plan (USDA Forest Service 1988b, 1988c, 1992).

As part of a select group of national forests, the Inyo initiated plan revision in 2012 along with the Sierra and Sequoia National Forests to implement the newly adopted planning rule. The three national forests released one draft environmental impact statement in 2016. Managers initiated the process of revising their plan in 2012 as part of a select group of national forests to implement the newly adopted planning rule. Due to the changed condition with drought-induced tree mortality on the west slope of the Sierra Nevada range, and the need to reconsider plan direction and potential new needs with the changed condition, we decided to provide supplemental analysis for the Sierra and Sequoia National Forests plan revision effort and produce a final environmental impact statement and land management plan for the Inyo National Forest.

About the Inyo National Forest

The Inyo National Forest is located in eastern California, with a small portion in Nevada (figure 1). The Inyo includes the crest and eastern escarpment of the Sierra Nevada Mountains from Mono Basin to the Kern Plateau, plus the Glass, White, and Inyo Mountain Ranges. The Inyo encompasses approximately 2 million acres, including about 56,481 acres of private and State lands and 26,711 acres of the Sierra National Forest and Humboldt-Toiyabe National Forests, which are administered by the Inyo National Forest. The Inyo contains 116,200 acres of Mono Basin National Forest Scenic Area and the 29,000-acre Ancient Bristlecone Pine Forest National Protection Area (a botanical special interest area). Other land managers in the region include the Bureau of Land Management and the Los Angeles Department of Water and Power.

Forty-six percent of the Inyo, (964,360 acres) consists of nine designated wilderness areas, either wholly or partially within the administrative boundary of the national forest. These areas include: Ansel Adams (shared with the Sierra National Forest), Boundary Peak, Golden Trout (shared with the Sequoia National Forest), Hoover (shared with the Humboldt-Toiyabe National Forest), Inyo Mountains (shared with Bureau of Land Management), John Muir (shared with the Sierra), Owens River Headwaters, South Sierra (shared with the Sequoia), and White Mountains Wildernesses.

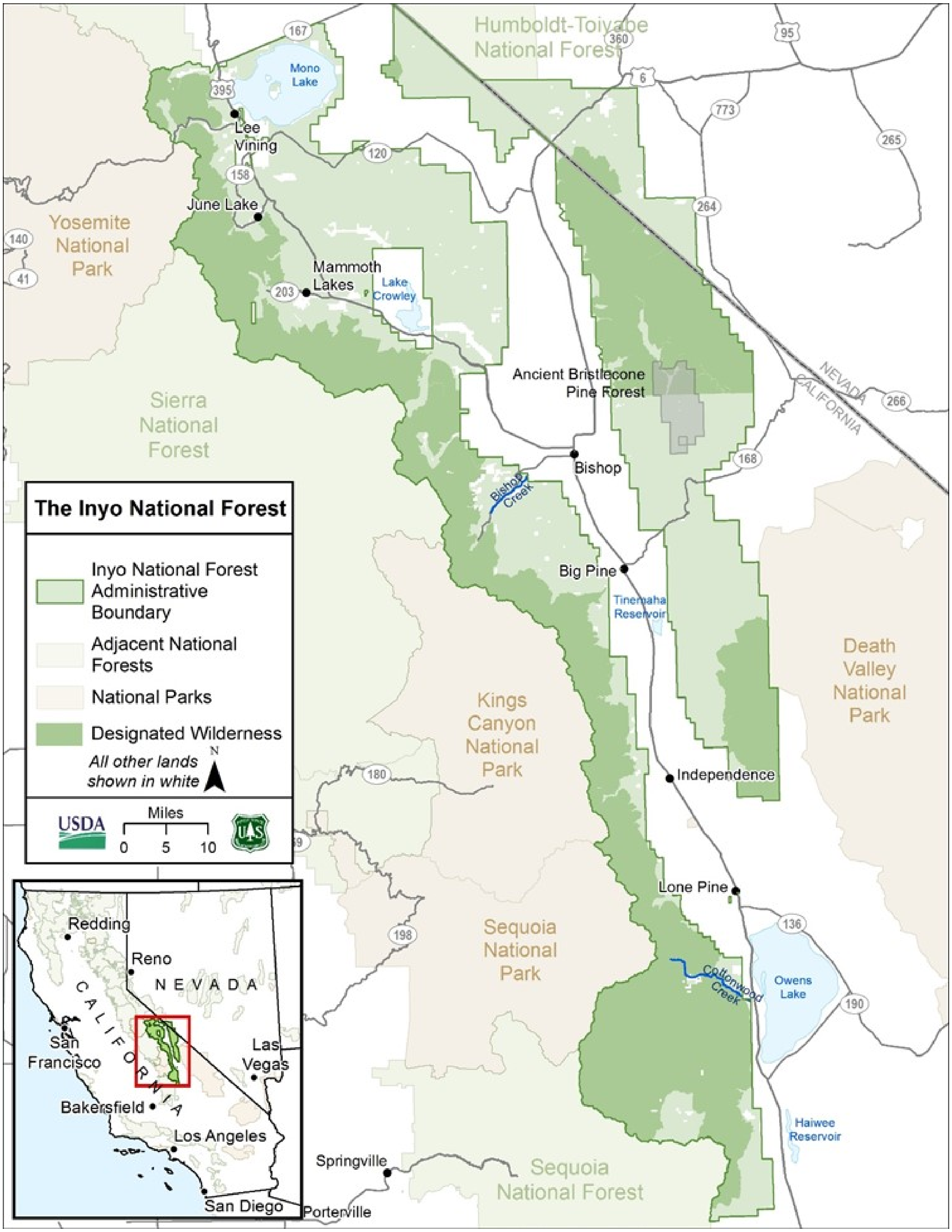

Figure 1. Map of the Inyo National Forest, which constitute the plan area for revising the forest plan for this national forest

The Inyo National Forest Supervisor's Office is centrally located in Bishop, California. The Inyo has four administrative ranger districts. The northern ranger districts, Mono Lake and Mammoth, are managed together as the "north zone." The southern ranger districts, White Mountain and Mount Whitney, are managed together as the "south zone." The Inyo National Forest comprises portions of Inyo, Mono, Madera, Fresno and Tulare Counties in California and Esmeralda and Mineral Counties in Nevada. The communities within and adjacent to the Inyo are relatively small and discrete. Key communities adjacent to the Inyo include Lee Vining, June Lake, Mammoth Lakes, Bishop, Big Pine, Independence, and Lone Pine.

Regulatory Direction

In 1976, National Forest Management Act[4] directed the Forest Service to develop land and resource management plans (hereafter referred to as "forest plans") and use the direction in them to manage the natural resources and human uses of each national forest. The National Forest Management Act and its implementing regulations[5] require every national forest to revise its land management plan: every 10 to 15 years; when conditions or demands in the area covered by the plan have changed significantly; when changes in agency policies, goals, or objectives would have a significant effect on forest level programs; and when monitoring and evaluation indicate that a revision is necessary.

The Inyo National Forest completed their first forest plan in 1988. The current plan has incorporated several amendments, including the 2004 Sierra Nevada Forest Plan Amendment, the 2007 Sierra Nevada Forests Management Indicator Species Amendment, and other local amendments.

In addition to the National Forest Management Act, there are many other laws and regulations that apply to management of the national forests including, but not limited to, the Clean Air Act, Clean Water Act, Endangered Species Act, and National Historic Preservation Act. These laws are generally not repeated or referenced in a forest plan unless there is an issue that merits citing direction in the law. Additional direction and policy for management of national forests are provided in executive orders, the Code of Federal Regulations, and the Forest Service directives system, the latter of which consists of Forest Service manuals and Forest Service handbooks. Such direction is also not repeated in a forest plan.

Plan Revision under the 2012 Planning Rule

In 2012, the U.S. Department of Agriculture issued a new rule for forest planning. The 2012 Planning Rule emphasizes that forest plans are to guide management of the national forests so they are ecologically sustainable and contribute to social and economic sustainability. The national forests are managed to provide ecosystems and watersheds with ecological integrity and diverse plant and animal communities. In addition, they are managed to have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future.

[4] Public law 94-588

[5] See 36 CFR 219

The 2012 Planning Rule describes three phases to the planning process:

- assessment;
- development, amendment, or revision of forest plans; and
- monitoring[6]

In 2013 we completed a Bio-regional Assessment (USDA Forest Service 2014b)) of the conditions and trends of resources, uses, and public interests that are common across the Sierra Nevada. This was followed by individual national forest assessments to frame the larger context for the Inyo, Sequoia, and Sierra National Forests in relation to the rest of the national forests in the Sierra Nevada (from the Sequoia National Forest all the way to the Modoc National Forest near the Oregon border).

Public involvement efforts helped us identify the needs for changing our plan as well as a proposed action and alternatives for developing the plan. Although we have planned the monitoring program as part of our proposed action, it will not be implemented until after the forest plan is revised.

Forest Plan Content

Forest plans provide a framework for integrated resource management and for guiding project and activity decisionmaking. Plans themselves do not compel any action, authorize projects or activities, or guarantee specific results. Instead, they provide the vision and strategic direction needed to help managers create a national forest that is ecologically, socially, and economically sustainable.

The revised plan includes “plan components” and “other content.” Once approved, any substantive changes to plan components will require a plan amendment. Administrative changes may be made for corrections of clerical errors or conformance of the plan to new statutory or regulatory requirements, or other plan content as described in 219.7(f). The public is notified of all plan amendments and administrative changes before they become effective.

Plan Components

A forest plan is a general framework to guide the national forest staff when they propose, analyze, and decide on projects and activities. The five required components of a forest plan are desired conditions, objectives, standards, guidelines, and suitability of lands. A plan may also include goals as an optional component.

- A **desired condition** is a description of specific social, economic, or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. This description is specific enough to allow progress toward achievement to be determined but does not include a completion date.
- An **objective** is a concise, measurable, and time-specific statement of a desired rate of progress toward one or more desired conditions. Objectives are based on reasonable foreseeable budgets.

[6] See the Planning Rule at 36 CFR 219.6; 219.7; 219.12; and 219.13.

- A **standard** is a mandatory constraint on project and activity decisionmaking, established to help achieve or maintain the desired condition, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- A **guideline** is a constraint on project and activity decisionmaking that allows for departure from its terms (more flexibility), as long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- **Suitability of lands** is determined for specific lands within the plan area. The lands are identified as suitable or not suitable for various uses or activities based on desired conditions applicable to those lands. The suitability of lands is not identified for every use or activity. A plan's identification of certain lands as suitable for a use is not a commitment to allow such use but only an indication that the use might be appropriate. If a plan identifies certain lands as not suitable for a use, then that use or activity may not be authorized unless a change in the plan is made.
- A **goal** describes an outcome that is not at the sole control of a national forest, such as the result of a partnership.

Other Plan Content

Other content in the forest plan consist of background information, general descriptions of areas to provide context to plan components, identification of watersheds that are a priority for maintenance and restoration, proposed and possible actions, and potential management approaches. Potential management approaches describe the principal strategies and program priorities each national forest intends to employ to carry out projects and activities under the plan. Potential management approaches may discuss potential processes such as analysis, assessment, inventory, project planning, or project monitoring.

The proposed plan **monitoring program** is based on the practice of adaptive management, which is broadly recognized as critical for managing natural resources. The adaptive management cycle includes: identifying the desired conditions (forest plan); activities to help us get there (project-level implementation); monitoring whether we are achieving the results we intended (monitoring program), and using those evaluations to improve our implementation activities or to amend the forest plans.

Purpose of and Need for Revising the Forest Plan

The purpose of revising the forest plan is to meet the legal requirements of the National Forest Management Act and the provisions of the 2012 Planning Rule. There is a need to revise the existing forest plan to: (1) address the changing social and environmental conditions over time, and public issues described below; and (2) guide natural resource management activities on the Inyo National Forest for the next 10 to 15 years.

The need for plan revision is directly correlated to seven overarching "needs for change" we identified during iterative pre-revision collaborative dialogues, meetings, tribal forums, studies and assessments (see the "Public Participation" section on page 8). The needs are: benefits to people and communities; tribal relations and uses; sustainable recreation; fire; ecological integrity; lands and designated areas. These efforts involved our forest plan revision team of interdisciplinary resource specialists and many public groups, organizations, agencies, officials, and individuals.

The Inyo assessment identified recent changes in ecological, economic, and social conditions and trends (USDA Forest Service 2013a, 2014a, 2014e). Broader issues were identified in the "Bio-regional Assessment" (USDA Forest Service 2014b) and "Science Synthesis" (Long, Quinn-Davidson, and Skinner 2014b). Using the information in these reports, the Inyo National Forest examined the current conditions and trends of ecosystems, ecosystem services, and benefits to people. Although the staff at the Inyo National Forest determined that much of the existing management direction contained in the forest plan is adequate to provide sustainable, integrated resource management, they identified several emphasis areas of management direction potentially needing change (USDA Forest Service 2014c, 2014d, 2014g).

While the forest plan revision effort is based on the need for change, we also took advantage of the opportunity to incorporate emerging climate change information, reclassify current standards and guidelines as desired conditions or other plan components where appropriate, and reduce duplication of Forest Service Handbook and Manual direction and existing laws, regulations, and policies.

From Needs for Change to Revision Topics

Each emphasis area we identified in the need for change was considered as a potential revision topic. Revision topics are used in the environmental impact statement to organize the features of the alternatives and to compare and contrast the differences between alternatives.

It is important to note that there is overlap in management direction developed to address each revision topic. For example, management direction developed to address needs under revision topic 2, ecological integrity, also addresses needs identified under revision topic 1, fire management.

Three of the emphasis areas we identified in the need for change were not considered to be revision topics because plan direction is the same in alternatives B, B-modified, C, and D. The need for change to incorporate plan direction for lands transferred to the Inyo National Forest under the National Forest and Public Lands of Nevada Enhancement Act was addressed by incorporating plan direction that essentially continued existing management and uses. The need for change to address benefits to people and communities and the need for change to address tribal relations and uses are both fundamental requirements of the 2012 Planning Rule and were incorporated throughout desired conditions and other plan direction. Since these two areas are fundamental requirements, the consequences of the alternatives are displayed following the revision topics.

Each revision topic listed below provides a brief description and explanation of what the topic is and what needs to be revised in the plans to address the topic. Further explanations supporting the needs for changing the current plans are described in the project record.

Revision Topic 1: Fire Management

There is a need to reduce the risk of large high-intensity wildfires to communities and assets such as recreation sites and infrastructure; increase the ability to manage wildfires to meet resource objectives;[7] and reduce smoke impacts to communities.

[7] A strategic choice to use unplanned wildfire starts to achieve resource management objectives and ecological purposes under specific environmental conditions. Such fires are monitored closely to ensure safe conditions for people, property, and other highly valued resources.

Revision Topic 2: Ecological Integrity

There is a need to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought and climate impacts; restore wildlife and plant habitat and diversity; and reduce the risk of large high-intensity wildfire impacts to species and wildlife habitat.

Revision Topic 3: Sustainable Recreation and Designated Areas

There is a need to provide sustainable and diverse recreation opportunities that consider population demographic characteristics; reflect desires of local communities; avoid overcrowding and use conflicts, and minimize resource damage; protect cultural resources; update direction for management of wilderness and wild and scenic rivers; and protect the values of the Pacific Crest National Scenic Trail.

The Revised Plan

We prepared the revised Inyo National Forest Land Management Plan in an iterative fashion with the public over a 5-year period, beginning with the preparation of the assessments. The draft forest plan is designed to provide strategic, program-level guidance for management of the national forest, including natural resources and uses, over the next 10 to 15 years. For each of the revision topics described above, the plan revision team, in collaboration with the public and other agencies developed a proposed revised plan, that:

- provides a context for future, project-level planning;
- identifies strategies to maintain or achieve goals (like desired conditions) over time;
- identifies land areas as generally suitable or unsuitable for various uses;
- identifies standards and guidelines to guide the planning of projects and activities;
- identifies areas with special or unique characteristics;
- provides monitoring and evaluation requirements; and
- emphasizes the use of best available science and adaptive management.

Specific details of the revised forest plan, as it evolved from the public collaborative process and internal evaluations that have occurred, are provided in chapter 2 and referenced as “alternative B.” A copy of the revised forest plan is provided as a companion document to this environmental impact statement.

Decision Framework

The responsible official for this proposed action is the Forest Supervisor of the Inyo National Forest. After reviewing the results of the analysis evaluated in the final environmental impact statement, the responsible official will issue a record of decision, in accordance with agency decisionmaking procedures[8] that will:

- disclose the decision (identify the selected alternative) and reasons for the decision,
- discuss how public comments and issues were considered in the decision, and

[8] 40 CFR 1505.2

- discuss how all alternatives were considered in reaching the decision, specifying which one is the environmentally preferable alternative.[9]

Approval of the revised plan will identify management areas and will include recommendations for areas that can only be designated by statute, such as wilderness and wild and scenic rivers.

Public Participation

The Inyo National Forest provided opportunities for public participation throughout the plan revision process. We used both formal and informal collaboration methods to prepare for and carry out plan revision. We developed a “Collaboration, Tribal and Public Involvement Plan” to guide interactions with other agencies and the public.

Early Public Engagement Sessions – Informal collaboration began even before the final Planning Rule was released with a “Sierra Cascades Dialog” public engagement session held in Sacramento, California on the topic of “Preparing for Forest Planning” in December 2011. This was followed with additional dialog sessions on collaborative planning, adaptive management and recreation, social and economic opportunities and impacts, and monitoring.

Based upon input from the public during the Sierra Cascades Dialog meeting in 2011, the Forest Service Pacific Southwest Research Station produced a science synthesis (Long, Quinn-Davidson, and Skinner 2014c) to examine the current science for a set of topics that were determined to have changed since the 1996 Sierra Nevada Ecosystem Project[10] (Centers of Water and Wildland Resources 1996 (Resources 1996)). In addition, although not required, a Bio-Regional Assessment (USDA Forest Service 2014b) was prepared to provide the context for examining resources across the entire Sierra Nevada range.

Continued Public Engagement Sessions – In 2013, we held one Sierra Cascades Dialog session to discuss the science synthesis and two dialog sessions to discuss the Bio-Regional Assessment. To allow the public to directly provide information about conditions and trends for 18 resource topics outlined in the 2012 Planning Rule, we prepared both the Bio-Regional Assessment and the national forest assessments using an open wiki site called the “Living Assessment.” We used public input received between January and September 2013 to create the Bio-Regional Assessment (USDA Forest Service 2014b), and the Inyo National Forest Assessment (USDA Forest Service 2013a).

Notice to Initiate Plan Revision – Following the assessments, we issued a notice to initiate plan revision on December 26, 2013 and developed a preliminary document outlining the need for changing the forest plans. We held tribal forums and public workshops in mid- to late-January 2014 in Bishop to present and collect feedback on the preliminary need for change. Based on public feedback, we revised the need for change and presented an updated version along with draft desired conditions. We collected feedback at another set of tribal forums and public workshops in mid-June of 2014 in Bishop.

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[9] Environmentally preferable alternative is defined in 36 CFR 220.3.

[10] The Sierra Nevada Ecosystem Project was requested by Congress as a scientific review of the remaining old growth in the national forests of the Sierra Nevada in California, and a study of the entire Sierra Nevada ecosystem by an independent panel of scientists, with expertise in diverse areas related to the issue.

Notice of Intent and 30-day Scoping Comment Period – A notice of intent to revise the Inyo, Sequoia, and Sierra forest plans and to prepare an environmental impact statement was published in the Federal Register[11] on August 29, 2014, initiating a 30-day public scoping period. We circulated a detailed proposed action along with the notice of intent. The detailed proposed action provided potential plan components and other plan content focused on the revision topics of the purpose and need to revise the plans. Tribal forums and public meetings were held in Fresno, Porterville, and Bishop in mid-September 2014 to provide an update on the revision process and seek public input on the development of alternatives for the draft environmental impact statement.

During the 30-day comment period, we received approximately 7,317 emails and letters from individuals, agencies, organizations, Tribes and governments commenting on the purpose and need and proposed action. Of the comments received, approximately 6,603 represented form letters. All comments received were sorted, grouped by subject and analyzed to determine concerns and issues. In mid-November 2014, we held a set of tribal forum and public meetings in Fresno, Porterville, and Bishop to share a preliminary summary of the comments received and an initial set of conceptual alternatives.

Other public involvement occurred as required by the planning rule related to developing the list of species of conservation concern, evaluating the suitability of lands, and developing the monitoring program.

90-day Comment Period on Inyo, Sequoia, and Sierra Draft Environmental Impact Statement – A notice of availability to comment on the Inyo, Sierra, and Sequoia forest plans and environmental impact statement was published in the Federal Register[12] on May 27, 2016, initiating a 90-day public comment period. The public comment period ended on August 29, 2016. Tribal forums and public meetings were held in Fresno, Porterville, and Bishop in August 2016 to provide information and seek public input on the draft revised forest plans and the draft environmental impact statement.

During the comment period, we received a total of 32,837 emails and letters from individuals, agencies, organizations, Tribes and governments commenting on the draft environmental impact statement. Of these letters, 900 were designated as unique letters and 2,980 were determined to be duplicate submissions. Twenty-nine sets of form letters were received, reflecting a total of 28,982 form letters received. All comments received were sorted, grouped by subject and analyzed to determine concerns and issues.

The Comment Analysis and Response Application (CARA) system, was used to organize and do an initial analysis of the letters. Letters were categorized into three categories: unique, form, and form plus letters. Unique letters, are comments received that have all original content from its author. Form letters are comments received that contains one main letter with original content from an author that has be submitted by multiple parties replicating the content from the original letter. Form plus letters are comments received that are a mix of the two previous categories. Form plus letters are comments that have content from the original form letter but also contains unique content from the party submitting the letter. CARA assigned each letter, regardless of category, a unique numerical identifier (called a letter number). Letters that were received via

[11] 79 FR 51536

[12] 79 FR 51536

email or regular mail are scanned and uploaded into the CARA system to ensure all comments are assigned a letter number.

Each unique and form plus letter was read and reviewed, and each unique form letter was read and reviewed. The review of letters had five phases: comment coding, develop issue statements, development of possible resolution actions, responding to comments, and incorporating final resolutions into final documents. Each phase is discussed below.

Letters categorized by the CARA system were reviewed and coded by the Regional Forest Plan Revision Team (revision team). The revision team divided the letters among team members and reviewed them to identify specific comments as substantive concerns, issues, problems or disputes with information presented in the Draft Inyo, Sierra, and Sequoia Forest planning documents. This identification of substantive comments is referred to as coding comments. Coded comments were selected and labeled by subject matter and assigned an individual number connecting the comment to the letter it originated. Coded comments with similar subject matters were then grouped and developed into issue statements. Responses to coded comments, synthesized into concise statements and organized in a manner to reflect the public concerns was conducted by the revision team.

The revision team worked with staff, regional office directors, and forest supervisors to consider public comments, assess options, develop potential resolutions, and determine a preferred alternative for the final environmental impact statement.

After analysis of the comments and the substantial nature of the changed condition in the southern Sierra and the consequences to management needs, the revision team decided split the Inyo National Forest plan revision effort from the Sequoia and Sierra efforts as described previously.

Consultation with Federally Recognized Indian Tribes – The responsible official for the Inyo National Forest regularly met with federally recognized Indian Tribes to discuss the plan revision process and to engage in consultation as needed.

A description of the public participation process for forest plan revision can be found in the Forest Plan Revision Collaboration, Tribal and Public Involvement Plan in the project record.

Issues

The public, local and county governments, and State and Federal agencies submitted comments in response to the notice of intent during the 30-day scoping comment period and at public meetings. We reviewed all the comments to identify issues and frame their associated cause-and-effect relationships. We then separated the issues into two groups: significant and nonsignificant. Significant issues are those used to develop alternatives and modify the proposed action. Nonsignificant issues are identified as those: (1) outside the scope of the proposed action; (2) already addressed by law, regulation, the proposed revised plan, or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence.

Issues that Served as the Basis for Alternative Development

There are two broad categories of issues: (1) ecosystem or wildlife issues, and (2) management or use issues. Each category is followed by numbered issue topics, each of which are followed by a summarized issue statement and a description of the many concerns we heard during public comments and engagement sessions about the issue.

Ecosystem or Wildlife Issues

Issue 1: Ecological Resilience, Wildlife Habitats, and Wildfire

The amount, type, and location of thinning to improve ecosystem resilience to large, high-intensity wildfires and to reduce the threat of wildfires to communities may not provide adequate habitat for wildlife species that use forests with large trees and dense canopy cover.

There is concern about the type and extent of management activities included in the proposed action for restoring ecological resilience, particularly mechanical thinning. Based on perceptions of current vegetation conditions and resilience, some respondents stated the proposal is too aggressive, while others stated the restoration proposal is not aggressive enough. Some believe a more active management approach using thinning of trees and removing fuels to restore ecological resilience will impact too much of the dense forest that provides wildlife habitats in the short term. They prefer to use more prescribed burning and more carefully managed wildfires instead of mechanical thinning, and to limit mechanical thinning to only when needed closest to communities. Others think a more active management approach that substantially increases the areas thinned will reduce impacts from large, high-intensity wildfires and ensure that the forests are resilient to climate change. They believe that active management may have short-term impacts but is needed to provide long-term sustainability of wildlife habitat and other ecosystem services.

Issue 2: Forest Resilience and Forest Density

The limitations on effectively treating enough areas to reduce the density of trees and the level of fuels because of concerns for wildlife habitats will leave too much of the forest at risk of loss or unacceptable damage from wildfires or insect attacks during droughts exacerbated by climate change.

There is a concern that there are too many tightly packed trees in much of the current forests, which makes them susceptible to being attacked and killed by bark beetles and other insects when trees are stressed by droughts. The density of trees and high level of fuels that have accumulated also makes it easier for fire to spread quickly into tree crowns where it can kill more trees than would be expected under more natural conditions. Public concern is that overemphasizing wildlife habitat needs conflicts with the need to improve resilience and sustainability of the forest.

Issue 3: Fuels Treatments and Fire Management

The amount of prescribed fire and managed wildfire used to meet resource objectives may not be sufficient to restore fire in frequent-fire ecosystems. The amount of fire restored to the landscape may not be achievable without reducing existing fuels before treatment.

There is general agreement about the need to restore fire as an ecosystem function more widely on the national forest. There is a concern that in most areas, unless existing fuels are reduced beforehand, it will be difficult to conduct prescribed burning because the fire will burn hotter than desired and will have too great a potential to escape control. There is also a concern that many prescribed burns may not be accomplished because fire managers would need to wait for optimal weather where the conditions for burning and risks are acceptable. Similarly, the concern is that wildfires that might be suitable for managing to meet resource objectives will continue to be suppressed unless there are strategic pre-treated locations to provide confidence that the fire can be safely managed without undue risks to communities or unacceptable impacts to resources.

Issue 4: Watershed Restoration

The amount of watershed restoration in the proposed revised plans may not keep pace with the increased stresses to aquatic and riparian systems from drought and climate change.

There is a concern that with climate change and drought, aquatic and riparian ecosystems are under increasing stress and in need of restoration to increase their resilience. Stresses include the threats of uncharacteristically large wildfires that affect large portions of watersheds and riparian areas, decreases in available water and a resulting increase in water temperature due to increased forest density where more trees draw water to grow, and drying of meadows and unique features like fens and springs. Since aquatic and riparian systems are an essential component to sustain ecosystem integrity, the concern is that without an increased pace and scale of restoration to address these stressors, aquatic ecosystems will continue to degrade with less water and warmer water temperatures that may make it difficult or impossible for aquatic organisms to survive.

Issue 5: Protecting Aquatic Diversity

The proposed revised plans may not adequately protect areas of high aquatic species diversity.

There is a concern that if we don’t identify and provide additional protection to areas of high aquatic species diversity, they may be adversely affected by the pace and scale of restoration. Maintaining and improving the resilience of these areas of concentrated species diversity is thought to be important as an adaptive strategy to address climate change.

Management or Use Issues

Issue 6: Recommended Wilderness

The proposed revised plans offer an opportunity to manage more areas as recommended wilderness to protect them from development for future generations. However, recommending additional wilderness areas in the proposed revised plans might unnecessarily prohibit and further geographically constrain management activities and uses, including tribal uses that would otherwise be allowed.

The 2012 Planning Rule and Forest Service directives provide direction during forest plan revision on a process to inventory and evaluate lands that may be identified as recommended for inclusion in the National Wilderness Preservation System. During the 30-day scoping comment period, some individuals and groups identified areas to consider in the wilderness inventory and suggested they become recommended wilderness areas. They asked that these or other additional areas be proposed for wilderness designation to protect the values that they attach to wilderness areas. Other people requested that no additional areas be proposed for wilderness designation because this would prevent them from participating in the activities that they currently enjoy within those areas. In particular, Tribes, tribal groups and organizations, and traditional cultural practitioners expressed concern that access and use of sites where resources are gathered and ceremonies are held may be restricted if areas are managed as wilderness. There is also a concern that sacred sites and cultural resources may be damaged or vandalized if recreation use increases with wilderness designation. Some commenters felt wilderness designation could also limit management activities that provide economic benefits while reducing the risks of uncharacteristic wildfire, insect, and disease disturbances.

Issue 7: Smoke

Increasing the amount of prescribed burning, and allowing the management of wildfires to meet resource objectives would produce more smoke that might impact human health and affect the tourism-based and resource-based economies of counties and rural communities.

Recent very large wildfires in Sierra Nevada national forests have demonstrated that smoke can affect not only local communities but also communities far from the fire. Smoke can affect human health and recreation opportunities. These impacts may affect other uses of the national forest and can be substantial for communities dependent upon a recreation-based economy. There is a concern that increasing the amount of prescribed burning and managing more wildfires to meet resource objectives will produce too much smoke that will affect human health and, if not carefully planned and managed, it could affect local economies.

Issue 8: Forest Products

The amount of forest management activities and forest product outputs may not adequately contribute to sustaining local and regional industry infrastructure needed to accomplish restoration objectives.

Many commenters emphasized the importance of economic and social contributions of the national forest to the surrounding communities. One concern is the importance of maintaining infrastructure (such as mills, roads, equipment, and skilled labor force) in local communities, so that the Forest Service can draw upon that infrastructure to accomplish restoration goals as well as contribute to the economic and social well-being of communities.

Chapter 2.
Alternatives, Including the Proposed Action

Introduction

This chapter describes the proposed action for revising the existing forest plans and alternatives to the proposed action. We have developed and analyzed five alternatives in this environmental impact statement; the proposed action is referenced as alternative B, the preferred alternative is Alternative B-modified. Alternatives are described by the different ways they address the revision topics and the relevant needs for change. The alternatives provide a framework for analyzing different ways of guiding land and resource management activities, achieving the purpose and need and addressing the issues described in chapter 1. The key purpose of this chapter is to describe the alternatives and present the effects of the alternatives in comparative and summary form, so that the differences between each alternative can be readily discerned. The details of alternative B-modified are provided in the final "Land Management Plan for the Inyo National Forest."

Alternatives Considered in Detail

Five alternatives are analyzed in this environmental impact statement: the no-action alternative (alternative A), which represents the existing plan (as amended), and four other alternatives: alternative B (draft forest plan), alternative B-modified (final forest plan), and alternatives C and D, which respond to the needs for change and issues identified from public involvement. The alternatives present a range of analysis options, as required by National Environmental Policy Act regulations.[13]

Alternative Development and Refinement Process

Alternative B

Alternative B, the proposed action, was developed to address the needs for changing the forest plan (as identified in chapter 1), as well as to carry forward existing forest plan direction that is still relevant. Information we gathered from the public and Tribes during the collaborative process consisted of public comments, the Bio-Regional Assessment, an individual national forest assessment, and the Forest Service Pacific Southwest Research Station's Science Synthesis. All of this information contributed to refining the needs for change and creating a proposed action for revising the forest plan, as well as to developing the other alternatives.

Alternative B-modified

Alternative B-modified is fundamentally alternative B with modifications to respond to public comments and to refine the concepts originally presented in the draft forest plan. The alternative responds to Issue 3: Fuels Treatments and Fire Management by correcting the underlying data used in the modeling of fire zones to better represent refinement of fire management zones. The model inputs were also changed in the form of removing the visual quality input and the northern goshawk habitat, constraining the California spotted owl habitat, and reassigning areas of low

[13] See 40 CFR 1502.14

elevation sagebrush to the general protection zone rather than restoration zone to protect sagebrush habitat from negative fire effects.

The alternative responds to Issue 4: Watershed Restoration and Issue 5: Aquatic Diversity by replacing the concept of critical aquatic refuges with conservation watersheds. New plan components were written for the conservation watersheds to provide for long-term maintenance and restoration of functioning watersheds providing habitat for the persistence of species of conservation concern. The plan was reformatted to display all the plan components associated with aquatic, riparian, and watershed resources in one area to better reflect a cohesive aquatic strategy.

The sustainable recreation direction was modified to provide more developed and cohesive plan direction. The concept of “places” (descriptive management areas without plan components) was replaced with a three-zone approach to recreation management. The desired recreation opportunity spectrum was mapped and plan components developed, to manage the recreation setting and built environment. A winter recreation opportunity spectrum map was developed to reflect winter over-snow settings.

The final plan and environmental impact statement also made changes to the area considered for timber suitability. Additional eligible sections of wild and scenic rivers were added between the draft and final statements along with refined boundaries for proposed wilderness areas, and those areas were removed from the area considered for timber suitability. Additionally, riparian conservation areas were removed from the area of timber suitability.

Alternative C

Alternative C was developed to address Issues 1, 3 and 5, emphasizing prescribed fire as a management tool, rather than mechanical thinning and harvest. Management would focus on treating small-diameter trees using mechanical and hand treatment methods instead of removing trees across a range of tree diameters, and on follow-up prescribed burning within treated areas.

Mechanical treatments in alternative C would emphasize vegetation and fuel reduction treatments in the wildland-urban intermix defense zone to minimize the threat of large high-intensity wildfires to communities and there would be less fuel reduction treatment in wildland areas. The treatments in the wildland-urban intermix defense zone would focus on implementing and maintaining a pattern and intensity of effective fuel reductions to lower the intensity of wildfires immediately adjacent to communities. Alternative C also emphasizes greater salvage logging restrictions and maintenance of important habitat structures in complex early seral habitat.

Alternative C adds the most critical aquatic refuges. Direction for riparian conservation areas remains similar to alternative B, but would not include the exception to allow mechanical thinning within riparian conservation areas to facilitate burning there.

Alternative C includes the most area of recommended wilderness of all alternatives including many areas the public identified for consideration. It also includes the most areas that would be managed as critical aquatic refuges, including many areas the public identified for consideration. Alternative C also increases the size of the management area for the Pacific Crest National Scenic Trail to include areas that offer iconic views to better provide for scenic values of the trail.

Alternative D

Alternative D was developed to address Issues 2, 3, and 8 by increasing the intensity of treatments and the area where fuels are pre-treated using mechanical methods in combination with strategic treatment locations to favor larger landscape prescribed burns. This approach allows for prescribed burning across larger landscapes and provides more opportunity to manage wildfires to meet resource objectives. It allows removal of more trees, which helps managers more rapidly address desired conditions to reduce stand density and drought-related stress on residual large and old trees, and improve overall resilience of vegetation.

Alternative D emphasizes strategic mechanical thinning and prescribed burning treatments in the community wildfire protection zone, closest to communities, and the general wildfire protection zone, where fires can originate and have a high probability of reaching communities, to minimize the threat of large high-intensity wildfires. Alternative D also treats more area within the wildfire restoration zone increasing the potential to manage wildfires to meet resource objectives.

Alternative D also addresses Issue 6 by not recommending any additional areas for wilderness designation. Critical aquatic refuges are the same as alternative B. Direction for riparian conservation areas remains the same as alternative B.

Issue 4, concern regarding the pace and scale of watershed restoration, is addressed by having the greatest amount of stewardship project opportunities related to the increased amount of mechanical fuel reduction. Issue 7, concern regarding the potential of smoke to affect local community health and economic sustainability, is addressed by increasing the amount of mechanical fuel reduction prior to prescribed burning and by increasing the opportunity to manage wildfires to meet resource objectives through the use of strategically located treatments and larger landscape prescribed burning.

Features Common to Alternatives B, B-modified, C, and D

Species of Conservation Concern

The National Forest Management Act requires the Forest Service to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives.” As such, the 2012 Planning Rule requires the Forest Service to maintain or restore ecological sustainability, integrity, and diversity as the primary approach to species conservation. In addition, the rule requires plan components to provide the ecological conditions to maintain a viable population of species of conservation concern. A viable population is defined as one “that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments.” Species of conservation concern are those species that are known to occur within the plan area and for which there is a substantial concern about the species’ capability to persist over the long term in the plan area. As required by the Planning Rule and agency directives, the Regional Forester has identified a list species of conservation concern for the Inyo National Forest, which does not vary by alternative. These species are listed in the section “Wildlife, Fish and Plants.”

Alternatives B, B-modified, C, and D (also referred to as “the revised plan alternatives”) identify vegetation desired conditions designed to provide overall ecological integrity, including habitat for all associated species, and specifically to ensure they provide the ecological conditions necessary to maintain viable populations of species of conservation concern within the plan area. A guideline was developed to protect trees from removal that are used for nesting, denning, or roosting by at-risk species. This extends to some adjacent trees that provide necessary shade or other important habitat conditions. In addition, a guideline was developed to consider at-risk species early in the environmental planning process.

The revised plan alternatives identify desired conditions, standards, and guidelines for special habitats that represent small-scale habitat or vegetation types that support many at-risk plants and animals. These special habitats have plan direction to increase their consideration in project design and to help maintain and improve key ecological conditions that support several plant species of conservation concern.

For some species of conservation concern, species-specific plan components have been developed or carried forward from the existing plans and are the same across alternatives. These species include Lahontan cutthroat trout, Paiute cutthroat trout, golden trout, and Sierra marten. Species-specific plan components related to willow flycatcher and great gray owl are not carried forward from the existing plans.

Willow Flycatcher

Species-specific plan direction for willow flycatcher is not being carried forward into plan revision. Current direction includes survey requirements and livestock grazing direction for occupied sites. However, there is no overlap of occupied sites and livestock grazing; therefore, additional species-specific plan direction is not necessary.

Great Gray Owl

Great gray owl is known to forage on the Inyo National Forest but there are no known nest sites. Great gray owl is a species of conservation concern in the plan area, but there are no species-specific plan components. There is a species-specific potential management approach to conduct additional surveys using established protocols to follow up on reliable sightings of the owl.

Sierra Marten and Pacific Fisher

Species-specific plan direction for Sierra marten and Pacific fisher incorporates recent mapping of Pacific fisher and marten core habitat and information from the “Science Synthesis and Climate Adaptation Strategy for the Sierra Nevada.” Much of fisher core area 1 and marten core habitat overlaps with wilderness or inventoried roadless areas and would have limited management. Additional desired conditions and guidelines address management of core habitats to restore and maintain habitat quality and resilience to climate change. A limited operating period minimizes disturbance to fisher in core area 1 but allows some exemptions for beneficial activities. Although plan direction related to other species varies by alternative and may also affect marten and fisher habitat, the revised plan alternatives include plan direction to incorporate Sierra marten and Pacific fisher core habitat and conserving the key habitat characteristics.

Tribal Relations and Uses

Desired conditions, goals, and potential management approaches in the revised plan alternatives address and encourage working with Tribes to manage resources of tribal importance. Plan components focus on management of some sites for tribal uses such as oak stand improvements for acorn gathering, management of pine stands for piaga (Pandora moth) on the Inyo National Forest, and other gathering site improvements and considerations.

Partnerships

An emphasis on increasing workforce capacity through the use of partnerships and volunteerism is included in plan direction in the revised plan alternatives. A variety of strategies and tools would be used to increase the use of private, public, and tribal partnerships and volunteers. Partnerships and volunteers could assist with improving and maintaining recreation trails, recreation and administrative sites and other types of infrastructure, providing information and interpretive services, as well as participating in ecological restoration that would include restoring meadows and other archeological, cultural, and ecological features. Partnerships may also provide additional funding or other resources to increase the types and levels of services offered and to support an increased pace and scale of ecological restoration. In each alternative, the type of partnership or volunteer emphasis may shift; however, the ability to maintain and increase partnerships and volunteerism will continue to exist.

Wild and Scenic Rivers

A new plan component is added for management of rivers identified as eligible for inclusion in the National Wild and Scenic River System as well as for rivers that have been found to be suitable in previous wild and scenic river studies and have previously been recommended by the Forest Service for inclusion in the National Wild and Scenic River System. The standard applies protection measures for these rivers until a decision is made through an Act of Congress or a suitability evaluation determines that an identified eligible river is not suitable. The wild and scenic river eligibility evaluation identified an additional 160 miles of eligible rivers or segments on the Inyo National Forest.

Nevada Enhancement Act Lands

The Inyo National Forest acquired approximately 44,600 acres of lands through the National Forest and Public Lands of Nevada Enhancement Act of 1988[14] (see figure 2). These lands have been managed consistent with the Bureau of Land Management's Tonopah Management Plan and would be fully incorporated into the Inyo forest plan. Desired recreation opportunity spectrum classes and scenic integrity objectives are assigned to these lands reflecting the current management condition.

Scenic Integrity

Scenic character would be managed using the direction of the Scenery Management System, which replaces the older Visual Management System in the existing forest plans. The Scenery Management System provides a systematic approach to inventory, analyze, and monitor scenic resources on National Forest System lands. It recognizes that landscapes are not static so objectives for scenery are grounded by naturally changing and evolving conditions that are described in the scenic character. The scenic character stability of the landscape becomes an element considered in implementing the management objectives related to restoration. This context ensures that objectives for scenery are linked to ecological changes rather than managing for a specific condition into perpetuity. Converting to the Scenery Management System advances the contemporary paradigm that both natural and cultural (built element) features are part of scenic character and contribute to "sense of place." Scenic integrity objectives describe the minimum thresholds for the management of the scenery resource, ranging from very high scenic integrity objectives to low. Scenic integrity objectives reflect changes in public perceptions and the importance of viewing scenery as well as integrating scenery resources with the overall management of the landscape. Sustainable recreation concepts are integrated into plan direction for restoration projects to improve and protect scenic character and contribute to improved scenic stability.

[14] Public Law 100-550 - Oct. 28, 1988; 102 Stat. 2749

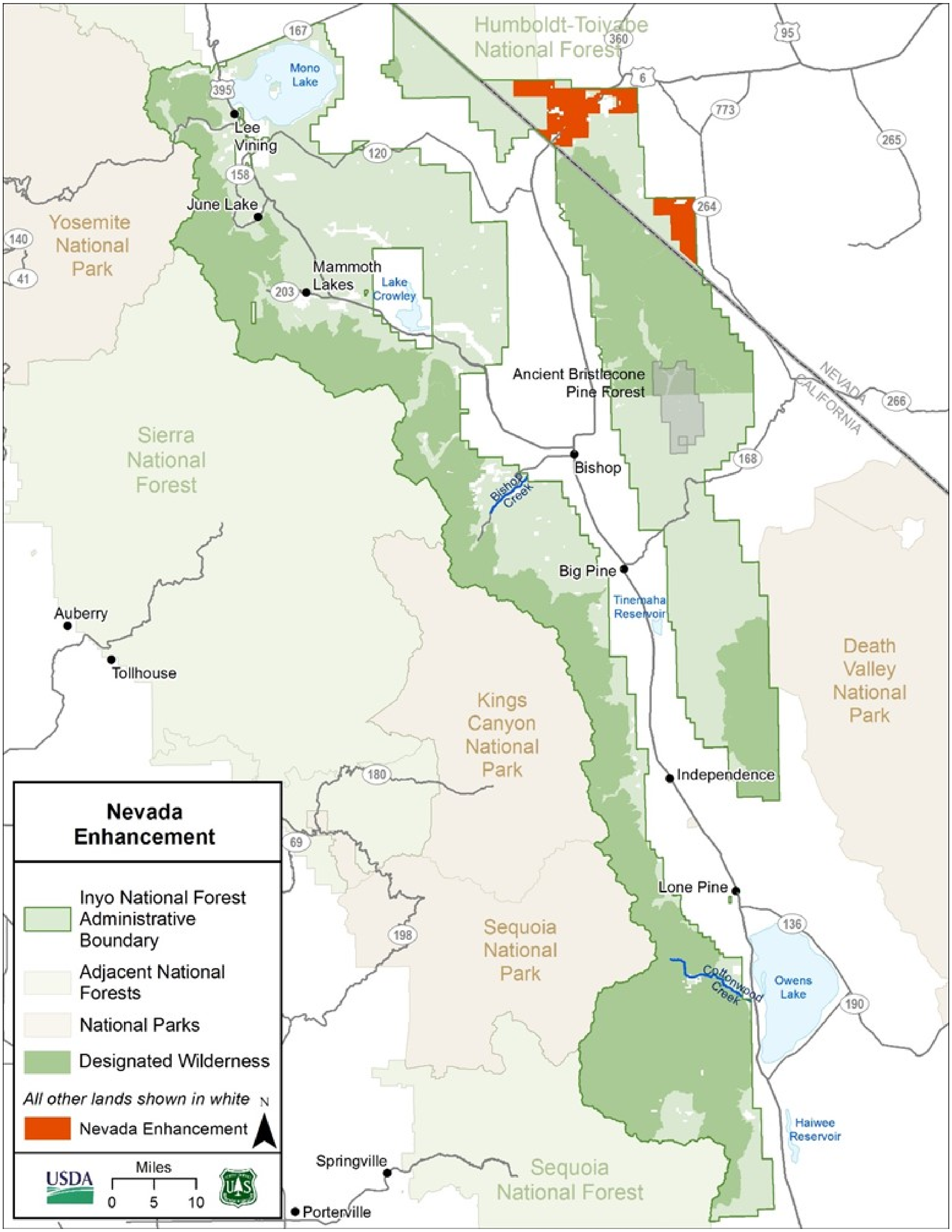

Figure 2. Location of Nevada Enhancement Act Lands on the Inyo National Forest

Invasive Species

The direction for invasive species is primarily focused on noxious weeds in alternative A. For the revised plan alternatives, the direction was updated and expanded to recognize the threats to ecosystem resilience from all nonnative invasive aquatic and terrestrial plants and animals likely to cause harm to ecosystems. There is an emphasis on managing invasive species by including objectives that increase the amount of area with nonnative invasive plants treated.

Climate Change

The Forest Service is addressing climate change in a variety of ways, from reducing the impacts of the operations of facilities to encouraging reduced impacts from permitted activities. The desired conditions for the revised plan alternatives include adaptations for climate change where relevant. An example is the climate adaptation strategy of providing for habitat connectivity to allow animals to move across the national forest more easily. Although they are not specifically addressed in the current forest plans, many of these strategies can and are considered during ongoing project development.

Alternative A: Existing Plan Direction

Under alternative A, the existing plans, as amended, would continue to guide management of the Inyo National Forest. An electronic copy of the existing forest plan is provided on the Forest Plan Revision website.[15]

The following sections discuss existing plan direction as it relates to each of the revision topics and needs for change.

Revision Topic 1: Wildland Fire Management

Strategic Fire Management Zones

Current forest plan management focuses hazardous fuel reduction treatment in the wildland-urban intermix defense zone and threat zone as a priority. In the defense zone (the area closest to structures and communities), there are fewer restrictions on the intensity of thinning (See chapter 3, “Wildland Fire Management” section for more information and volume 3 for maps of the strategic fire management zones).

Managing Wildfire to Meet Resource Objectives

The current forest plan encourages the restoration of fire to the ecosystem through increased use of prescribed fire and by allowing management of some wildfires when they can meet resource objectives defined by the forest plan. The existing plan provides general direction for resource objectives related to vegetation conditions, but they do not explicitly identify resource objectives to be accomplished using wildfire as a natural process.

Smoke and Air Quality

Prescribed fire is coordinated with adjacent land management agencies to ensure that State or Federal standards for ambient air quality are not exceeded.

[15] http://www.fs.usda.gov/detail/r5/landmanagement/planning/?cid=stelprdb5444003

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Current plan direction focuses on vegetation management and fuel conditions at the stand or patch scale and it does not explicitly provide a framework for increasing landscape-level treatments. Plan direction is generally prescriptive, with specific requirements and limitations on the diameter sizes of trees that can be removed and requirements to retain certain amounts of tree canopy cover. The landscape management approach is to strategically place fuel reduction treatments to interrupt the spread of large wildfires. However, because many areas are inaccessible due to steep terrain or distance from roads, and the current plan includes single-species-specific habitat management direction that limits treatment options, this approach has proven difficult to implement. This has left some wildlife habitats vulnerable to damage or loss from large high-intensity fires. The current forest plan describes the need to address stand density of forests to reduce the risk of trees dying due to stresses related to prolonged droughts, but single-species-specific habitat management direction limits the amount of treatment that can occur.

Old Forests

The current forest plan contains desired conditions for old forest emphasis areas and provides standards and guidelines to generally retain all large trees and to minimize treatments within patches of dense-canopy forests with larger trees wherever they occur. The desired conditions for old forest emphasis areas provide for high levels of horizontal and vertical canopy diversity, and variability in size, species composition, and structure of roughly even-aged vegetation groups generally less than 5 acres in size. However, these desired conditions conflict in part with the desired conditions and standards and guidelines for the California spotted owl, Sierra marten, and Pacific fisher, which generally favor retaining large contiguous areas of denser canopy cover and limit the ability to create a lot of horizontal and vertical canopy diversity. In some cases, the prescriptive plan direction for one species conflicts with direction for another species, which can limit the restoration of habitats as the most restrictive direction is applied to projects.

Wildlife and Plant Habitat Diversity

Risks to terrestrial habitat are mitigated in part by using restoration treatments (such as thinning, prescribed fire, and wildfires managed to meet resource objectives) at a landscape scale with the intent of reducing the impact of future large, high-intensity wildfires on key habitats each species needs. Despite the intent, the combination of protections for individual species often results in the inability to treat enough of the landscape to reduce the risks to habitat from wildfire.

Aquatic and Riparian Ecosystems

The current forest plan provides direction for an aquatic management strategy with desired conditions, goals, and a set of standards and guidelines organized around a set of riparian conservation objectives that includes delineation of riparian conservation areas around streams, rivers, lakes, meadows and a variety of other wetland types, and a set of critical aquatic refuges. The current standards and guidelines generally limit disturbance and impacts within riparian conservation areas and critical aquatic refuges and call for consideration of impacts to aquatic and riparian systems and resources.

Critical Aquatic Refuges

The current plan identifies a set of critical aquatic refuges focused on areas with threatened and endangered species or areas of other species with population concerns. The direction that applies to riparian conservation areas, the buffer area around streams, rivers, lakes, meadows, bogs, and other wetland types, applies to the critical aquatic refuges. There are 17 critical aquatic refuges on the Inyo National Forest.

Watershed Resilience to Climate Change

The desired conditions for aquatic and riparian ecosystems in the current plan does not specifically consider the change in temperature and precipitation related to climate change and other climate stressors to aquatic systems. Desired conditions do not exist connecting the condition of upland vegetation with the condition of aquatic and riparian ecosystems.

At-risk Species

At-risk species in alternative A consist of federally listed species under the Endangered Species Act and Forest Service sensitive species. The current forest plan employs an approach to species management that has a particular focus on providing habitats for species associated with old forest ecosystems and with aquatic and riparian systems, two of the issue areas identified in 2001 as needing new or amended plan direction. The current plan uses an approach primarily focused on limiting management activities within areas identified for wildlife management, especially protected activity centers for California spotted owl, northern goshawk, and great gray owl; home range core areas for California spotted owl; and den and rest sites for Sierra marten and Pacific fisher.

Bi-State Greater Sage-Grouse

Under the current forest plan, the Inyo National Forest would continue to follow the “Inyo National Forests Sage-Grouse Interim Management Policy” (USDA Forest Service 2012c) pending a forest plan amendment to better address the bi-state greater sage-grouse. In any plan amendment developed for sage-grouse, the Inyo National Forest would consider management direction that addresses current threats and, where feasible and applicable, would amend the plan to be consistent with the “Humboldt-Toiyabe National Forest Greater Sage-Grouse Bi-State Distinct Population Segment Forest Plan Amendment” to better achieve consistency across national forest boundaries. The Inyo National Forest would also continue to consider management direction and emphasize management actions that are consistent with the “Bi-State Action Plan: Past, Present, and Future Actions for the Conservation of the Greater Sage-Grouse, Bi-State Distinct Population Segment.”

California Spotted Owl

Species-specific plan direction for California spotted owl in the current plan provides for 300-acre protected activity centers designated around territorial locations and intended to provide sufficient habitat to support nesting owls. A surrounding home range core area encompassing an additional 700 acres surrounding the protected activity center, is identified to provide sufficient foraging and roosting habitat to support the home range needs of California spotted owls.

Great Gray Owl

The current plan includes designation of a protected activity center and standards and guidelines that provide for follow-up surveys, a limited operating period during the breeding season, and maintenance of herbaceous vegetation. However, there is no known nesting of this species on the Inyo National Forest.

Pacific Fisher

Under the current forest plan, the Southern Sierra Fisher Conservation Area is adjacent to but does not include the Inyo National Forest. Species-specific plan direction provides for 700 acre den site buffers around verified birthing and kit rearing dens with limited operating periods, minimizing fuels treatments to the extent possible and mitigating other disturbances. There are no known denning or birthing sites on the Inyo National Forest.

Sierra Marten

The current forest plan includes direction for establishing 100 acre den site buffers around den sites and minimizing disturbance and activities near den sites.

Sierra Nevada Bighorn Sheep and Nelson Desert Bighorn Sheep

The current forest plan contains direction to maintain and improve habitat, promote reestablishment to historic ranges, manage livestock where it poses a disease risk to bighorn sheep, mitigate impacts from recreation (Sierra Nevada Bighorn), and mitigate impacts of minerals extraction activities in bighorn sheep winter range.

Willow Flycatcher

The current plan includes standards and guidelines that guide livestock management by defining three categories of site occupancy: occupied willow flycatcher sites, historically occupied willow flycatcher sites, and conditionally occupied willow flycatcher sites.

Yosemite Toad

The current plan includes standards and guidelines that exclude livestock grazing within toad-occupied areas during the Yosemite toad breeding and rearing season. A standard and guideline allows waiver of the livestock exclusion if a site-specific management plan is approved and incorporated into allotment plans and relevant special-use permits.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

The existing plan direction was based on recreation uses and recreation demand existing and projected from the late 1970s and 1980s when forest plans were first developed. The emphasis of the current plan is on improving recreation opportunities by focusing on the maintenance, development, adaptation, or alteration of dispersed and developed recreation sites consistent with the recreation opportunity spectrum class of the area. There is an emphasis to continue existing partnerships and volunteerism and to evaluate opportunities to develop new partnerships and volunteers to increase the amount of trails and facilities managed to desired standards.

Scenery

In the current plan, scenic character is managed using the 1986 Visual Management System and associated visual management objectives, which do not include specific guidance for designing projects to improve scenic character and scenic character stability within the desired landscape character.

Designated Wilderness

General management direction exists but many designated wilderness areas have wilderness management plans that provide more specific management guidance.

Pacific Crest Trail

The current forest plan manages the Pacific Crest National Scenic Trail according to direction provided by a 1982 Comprehensive Management Plan (USDA Forest Service 1982) and direction is focused on the trail tread and immediate surroundings. Most of the Pacific Crest Trail is within existing wilderness areas except for 5 miles on the Inyo National Forest. In this area, there is limited specific plan direction to guide activities adjacent to the trail that may impact the scenic and recreational values of the trail.

Alternative B: Draft Revised Plan

Alternative B is the draft revised forest plan, which was developed in collaboration with the public, other agencies, government officials, and Native American Tribes to respond to the need for change emphasis areas. As described in chapter 1, the draft forest plan was adjusted from what was initially produced to address issues and feedback received by the public to date.

Alternative B provides a management direction framework to improve ecological fire resilience and restore fire as an ecosystem process. The draft forest plan establishes strategic fire management zones and emphasizes active management in the form of harvest, mechanical thinning, and prescribed burning to support the use of wildfire (natural ignitions) for resource benefit where it can be safely managed. The draft forest plan balances the need for a greater focus on landscapes and processes with protection for wildlife with the need for more active management. The draft plan addresses the fact that a prescriptive, single-species approach to forest management has significant limitations in terms of achieving long-term sustainability and diversity of ecosystems in the face of stressors and climate change, especially in areas closest to communities and where there are high concentrations of assets and values important to people. Management approaches are adjusted for scenery and recreation settings to integrate with restoration activities at a landscape scale and address adapting sites and infrastructure to the needs of shifting demographics, budgets, and climate change. Specifically, the draft forest plan strives to streamline and simplify standards and guidelines to allow for increasing the pace and scale of restoration projects designed to reduce the risks associated with large, high-intensity wildfires, drought, insect outbreaks, and climate change. The draft plan also strives to improve watershed conditions within the community wildfire protection zone and the general wildfire protection zone while providing for overall species diversity and the persistence of at-risk species, supporting recovery of federally listed species, and improving recreation sustainability.

The draft forest plan retains much of the direction from the existing forest plan; however, the draft forest plan differs in a number of fundamental ways that are aimed at allowing forest management to be more adaptable over time and to be able to adjust to site-specific conditions. Some concerns raised during the public scoping comment period were incorporated into the draft plan, either by modifying existing language or by adding new language. The following sections describe how alternative B responds to each of the revision topics.

Revision Topic 1: Wildland Fire Management

Strategic Fire Management Zones

Direction in the draft forest plan would replace the current two distance-based land allocations in the wildland-urban intermix and the remaining areas that are not wildland-urban intermix with four management areas based on a fire risk analysis consistent with the National Cohesive Fire Strategy (see chapter 3, "Wildland Fire Management" section for more information and volume 3 for maps of the strategic fire management zones).

- The Community Wildfire Protection Zone would replace the wildland-urban intermix defense zone of alternative A and includes larger geographic areas where wildfire would likely threaten communities. This zone is based on modeling potential spread and intensity of wildfires that have a very high likelihood of burning into and negatively impacting communities and community assets. Due to variations in the potential of fire, this zone is irregular in shape unlike the uniform shape of the wildland-urban intermix defense zone of alternative A. Draft plan direction emphasizes active management using thinning and prescribed fire to reduce fuels within this zone. Most wildfires would be actively suppressed to protect communities and assets, although in some instances, wildfires may be managed to meet resource objectives if environmental and fuel conditions allow and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed/direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management (see chapter 3, “Fire Management” section for more details). Plan direction identifies community buffers in close proximity to structures where fuel conditions, snags, and logs would be managed to facilitate safe wildfire operations.
- The General Wildfire Protection Zone would replace the wildland-urban intermix threat zone of alternative A; it is irregular in shape, covering a larger area. This zone is based on modeling potential spread and intensity of wildfires that have a very high likelihood of burning toward and negatively impacting communities and assets as well as negatively impacting natural resources in the zone. Draft forest plan direction emphasizes active fuel reduction treatments along ridgetops, roads, and other natural and manmade features that can serve as strategic anchor points for larger prescribed burns and to create areas of low fuel that can be used to manage wildfires. Due to the high likelihood of wildfire occurring in this zone and possibly spreading into the community wildfire protection zone, wildfires would most often be suppressed to reduce the threat to communities and assets. In some instances, wildfires could be managed to meet resource objectives if environmental and fuel conditions allow and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management.
- The Wildfire Restoration Zone would be a new zone that identifies areas with low to moderate risk for communities and structures and other resource values. This zone is based on modeling potential spread and intensity of wildfires that can pose a mix of positive and negative effects to resources and some isolated assets. Thinning or prescribed burning may be needed before wildfires can safely be managed to meet resource benefits. Proposed plan direction emphasizes active fuels management treatments in strategic locations to enable larger prescribed burns and to aid wildfire management that focuses on restoring fire to the ecosystem. Many wildfires in this zone would be managed to meet resource objectives under specific environmental and fuel conditions and when it could be done in a safe manner, although in some instances wildfires may be suppressed. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management.
- The Wildfire Maintenance Zone would be a new zone that identifies areas with very low risk. This zone is based on modeling potential spread and intensity of wildfires that pose mostly a positive effect to resources. The wildfire maintenance zone is typically in the

higher elevations, wilderness, and remote areas where mechanical treatments are often not a management option, thus restoring the role of fire is important to achieve ecological sustainability. Most wildfires in this zone would be managed to meet resource objectives under specific environmental and fuel conditions and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management. Prescribed burning would be used here where it increases the opportunity to manage wildfires and restore fire-adapted ecosystems.

Managing Wildfire to Meet Resource Objectives

Forest plan direction would provide desired conditions and resource objectives that allow unplanned wildfire starts to be managed to meet resource objectives when conditions allow and it is safe to do so across the national forest. The conditions and opportunities to manage wildfires would vary by strategic fire management zone and plan direction would emphasize designing projects to reduce fuels in strategic locations to increase opportunities to manage unplanned wildfire starts in this way.

Smoke and Air Quality

Forest plan direction for prescribed fire and managing wildfires to meet resource objectives would emphasize considering the impacts of smoke locally and regionally.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Draft forest plan direction would incorporate the concepts of ecological restoration expressed in recent scientific publications such as "An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests" (North, Stine, O'Hara, et al. 2009) and "Managing Sierra Nevada Forests" (North 2012b). The draft forest plan creates a management framework that allows an increase in the amount of restoration treatments using thinning, prescribed fire, and wildfires managed to meet resource objectives to make progress toward desired conditions across the landscape.

Proposed plan direction would emphasize mechanical thinning and prescribed burning around communities and recreation areas and other forested areas. The draft forest plan increases emphasis on restoration of sagebrush ecosystems, especially to benefit the greater sage-grouse as described for "At-risk Species" on page 29.

Draft forest plan direction emphasizes treating along key roads and ridges and connecting natural openings like rock outcrops that can make it easier to implement larger prescribed burns and manage or suppress fires. Treatments would focus on drier sites near the roads and ridges where restoration would move vegetation toward desired conditions.

To address climate change, the draft forest plan includes desired conditions and direction for improving resilience to climate change in all vegetation types. In subalpine and alpine systems there is additional direction that focuses on the unique threats that these usually long-lived and slow-growing ecosystems (such as bristlecone pine) face as temperature and precipitation patterns change. The draft plan includes direction to manage for increased risk of insects and diseases and changed fire patterns and cycles in these ecosystems.

The draft forest plan added desired conditions for old forests, including the desired densities of large trees and large snags, and the desired proportion of the landscape that should be in old forest conditions. They include direction to increase the resilience of old forests and large or old trees to drought, climate change, and large, high-intensity wildfires, which acknowledges that the variation of forest types requires some flexibility in determining the best approach to improve resilience on the ground.

Complex Early Seral Habitat

The draft forest plan would include plan components to provide for key characteristics that are important to the ecological integrity of complex early-seral habitats after large fires or in large areas where trees have been killed by drought, insects, pathogens, wind or other events. This includes desired conditions for complex habitat characteristics, wide-spread distribution of snags, logs, and live trees, while considering the need for other resource objectives such as hazard tree removal, reforestation, and strategic fuel treatments.

Wildlife and Plant Habitat Diversity

The draft forest plan adopts the approach to species management of providing for ecological diversity and ecological integrity of habitat as the primary means to ensure the persistence of most species. Like the existing plan, the draft forest plan contributes to the recovery of federally listed threatened and endangered species and does not jeopardize proposed or candidate species, including the incorporation of relevant provisions of the “Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands” (USDA Forest Service 2015c) in the form of plan components. Proposed objectives moderately increase restoration treatments to trend terrestrial habitat toward the desired conditions at a moderate pace. There is an increased emphasis on restoring fire as an ecosystem process in fire-adapted ecosystems with frequent fire-return intervals (in ponderosa and Jeffrey pine, and mixed conifer stands). Additional desired conditions for vegetation provides for increased habitat heterogeneity for multiple species at both the fine scale as well as at landscape scales. Specific desired conditions and guidelines for individual vegetation types, old forest, and sagebrush provide ecological integrity of habitat for multiple species.

Aquatic and Riparian Ecosystems

Riparian Conservation Areas

Proposed direction for riparian conservation areas is nearly identical to that contained in the existing plan, except for the following changes. The draft forest plan:

- Streamlines and consolidates direction that is similar in nature resulting in fewer plan components;
- Removes direction that repeats laws, regulations, or policies;
- Drops the term “riparian conservation objectives” because of the potential for confusion with plan component “objectives;” and
- Modifies direction to allow prescribed burn ignitions and, where necessary, mechanical and hand treatments to restore ecological integrity and improve the resilience of riparian ecosystems to fire, drought, and climate change.

Critical Aquatic Refuges

The Inyo National Forest draft forest plan adds one additional critical aquatic refuge to their 17 existing refuges. The Forest Service evaluated all the proposed locations presented during scoping, and considered areas where at-risk aquatic species and/or biodiversity hotspots were present on national forest lands.

Watershed Resilience to Climate Change

The desired conditions for aquatic and riparian ecosystems in the draft forest plan recognizes changes in temperature and precipitation related to climate change and other climate stressors on aquatic systems. Desired conditions are for restored vegetation conditions within watersheds, which in turn improves the quantity of water available to improve aquatic systems and to be available for other uses. Draft forest plan direction emphasizes improving watershed resilience to wildfire and climate change by treating vegetation and reducing fuels over larger areas to lower the intensity of wildfires. Restoration emphasizes thinning to reduce the effects of past management that has resulted in very dense forests, and mitigating impacts from unmaintained roads when they impair watershed function.

At-risk Species

The 2012 Planning Rule defines two categories for at-risk species: (1) species that are federally recognized threatened, endangered, proposed, and candidate species; and (2) species of conservation concern. Species of conservation concern are native, known to occur in the plan area, and species with a substantial concern for their capability to persist over the long term in the plan area. The 2012 Planning Rule requires plan components to provide the ecological conditions necessary to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area.

As part of the plan revision process, coarse-filter plan components such as desired conditions were developed that describe the desired outcomes and conditions for terrestrial vegetation, riparian habitats and features, and aquatic habitats and features within the plan area. For most at-risk species, meeting and maintaining these desired conditions within the plan area and applying other standards or guidelines would help provide the habitat and key ecological conditions that would provide for their persistence and viability within the plan area. For a few species, additional species-specific plan components (desired conditions, standards, guidelines, and goals) were developed to better provide the habitats and key ecological conditions that provide for persistence and viability within the plan area.

The list of species of conservation concern identified by the Regional Forester for which the draft forest plan direction has been developed is described in the “Wildlife, Fish and Plants” section.

Bi-State Greater Sage-Grouse

Species-specific plan direction is added for the bi-state greater sage-grouse on the Inyo National Forest. The draft forest plan direction is based on the existing “Inyo National Forest Sage-Grouse Interim Management Policy (USDA Forest Service 2012c)” and, where appropriate, additional management direction has been developed consistent with the “Humboldt-Toiyabe National Forest Greater Sage Grouse Bi-State Distinct Population Segment Forest Plan Amendment.” The draft Inyo forest plan also includes management direction and emphasize management actions that are consistent with the "Bi-State Action Plan: Past, Present, and Future Actions for the Conservation of the Greater Sage-Grouse, Bi-State Distinct Population Segment."

California Spotted Owl

Species-specific plan direction for California spotted owl provides for 300-acre protected activity centers designated around territorial locations and intended to provide sufficient habitat to support nesting owls. A surrounding home range core area encompassing an additional 700 acres surrounding the protected activity center, is identified to provide sufficient foraging and roosting habitat to support the home range needs of California spotted owls.

Great Gray Owl

Great gray owl is known to forage on the Inyo National Forest but there are no known nest sites. Great gray owl is a species of conservation concern on the plan area, but there are no species-specific plan components. There is a species-specific potential management approach to conduct additional surveys using established protocols to follow up reliable sightings of the owl.

Sierra Nevada Bighorn Sheep and Nelson Desert Bighorn Sheep

The draft forest plan has similar direction as the current plan.

Yosemite Toad

The draft forest plan provides forestwide plan direction for at-risk species and therefore provides protection for Yosemite toad.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

Recreation opportunity spectrum classes have been updated and the management approach for recreation settings is integrated with ecological restoration approaches. The draft forest plan includes desired conditions to manage developed recreation sites for ecological, social, and economic sustainability and an objective for fuel treatment restoration activities to protect recreation site infrastructure. Management of opportunities, sites, and infrastructure are adjusted to respond to changing demographics, budgets, deferred maintenance, and climate change.

Scenery

The draft forest plan direction identifies scenic integrity objectives for the plan area using the Scenery Management System. Scenery setting management would be integrated with ecological integrity and restoration to improve scenic character stability within the desired landscape character. The draft forest plan includes plan components that require desired scenic integrity objectives be considered in the design of restoration projects.

Recommended Wilderness

The draft forest plan would make a preliminary administrative recommendation to include four additional areas in the National Wilderness Preservation System (South Sierra; Piper Mountain Addition; White Mountains East; and White Mountains West). These are also referred to as "recommended wilderness areas." All four areas are adjacent to existing designated wilderness area boundaries and total 37,039 acres.

Pacific Crest Trail

The forest plan would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor of the visual foreground landscape zone (up to one-half mile from the centerline of the trail where visibility is not obscured by terrain) as defined by the Scenery Management System. Management area-specific desired conditions, standards, and guidelines and a management approach would be included to protect the nature, purposes, and resource values of the trail from degradation by activities and development.

Alternative B-modified: Preferred Alternative for the Revised Plan

Alternative B-modified was developed to address public comments received on the draft forest plan. Key changes to alternative B that are now incorporated into alternative B-modified include: (i) development of new direction for the aquatic strategy including the identification of conservation watershed areas; (ii) development of sustainable recreation areas and associated plan components; (iii) additions and subtractions to the species of conservation concern list; and (iv) incorporation of the forest rangeland livestock grazing plan components.

Alternative B-modified is the preferred alternative for the revised forest plan. This alternative provides a management direction framework to improve ecological resilience to high-severity fire and restore fire as an ecosystem process. The revised forest plan establishes strategic fire management zones and emphasizes active management in the form of harvest, mechanical thinning, and prescribed burning to support the use of wildfire (natural ignitions) for resource benefit where it can be safely managed. The revised forest plan balances the need for a greater focus on landscapes and processes with protection for wildlife with the need for more active management. The revised forest plan addresses the fact that a prescriptive, single-species approach to forest management has significant limitations in terms of achieving long-term sustainability and diversity of ecosystems in the face of stressors and climate change, especially in areas closest to communities and where there are high concentrations of assets and values important to people. Management approaches are adjusted for scenery and recreation settings to integrate with restoration activities at a landscape scale and address adapting sites and infrastructure to the needs of shifting demographics, budgets, and climate change. Specifically, the revised forest plan strives to streamline and simplify standards and guidelines to allow for increasing the pace and scale of restoration projects designed to reduce the risks associated with large, high-intensity wildfires, drought, insect outbreaks, and climate change. Standards and guidelines also strive to improve watershed conditions within the community wildfire protection zone and the general wildfire protection zone while providing for overall species diversity and the persistence of at-risk species, supporting recovery of federally listed species, and improving recreation sustainability.

The revised forest plan retains much of the direction from the existing forest plan; however, the revised forest plan differs from the existing plan in a number of fundamental ways that are aimed at allowing forest management to be more adaptable over time and to be able to adjust to site-specific conditions. Some concerns raised during the public scoping comment period as well as those received on the draft plan were incorporated into the revised plan, either by modifying existing language or by adding new language. The following sections describe how alternative B-modified responds to each of the revision topics.

Revision Topic 1: Wildland Fire Management

Strategic Fire Management Zones

Alternative B-modified was created to correct errors to highly valued resources and assets (HVRAs) and make adjustments to the potential wildland fire operational delineation units (PODs), both variables used in the wildland fire risk assessment. The changes in HVRAs included correcting data errors in the asset HVRAs, constraining the California Spotted Owl HVRA, removing the northern goshawk HVRA, and removing the visual resource HVRA. POD boundaries were remapped to include contiguous areas of low-elevation sagebrush. POD-level adjustments were made to assign the final zone classification to general protection rather than restoration or maintenance (see supporting document, Strategic Fire Management Zones, FEIS updates in the project file).

Direction in the revised forest plan would replace the current two distance-based land allocations in the wildland-urban intermix and the remaining areas that are not wildland-urban intermix with four management areas based on a fire risk analysis consistent with the National Cohesive Fire Strategy using the modifications mentioned above (see chapter 3, “Wildland Fire Management” section for more information and volume 3 for maps of the strategic fire management zones).

- The Community Wildfire Protection Zone would replace the wildland-urban intermix defense zone of the current plan (alternative A) and includes larger geographic areas where wildfire would likely threaten communities. This zone is based on modeling potential spread and intensity of wildfires that have a very high likelihood of burning into and negatively impacting communities and community assets. Due to variations in the potential of fire, this zone is irregular in shape unlike the uniform shape of the wildland-urban intermix defense zone of the current plan. The forest plan direction emphasizes active management using thinning and prescribed fire to reduce fuels within this zone. Most wildfires would be actively suppressed to protect communities and assets, although in some instances, wildfires may be managed to meet resource objectives if environmental and fuel conditions allow and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management. Revised plan direction identifies community buffers in close proximity to structures where fuel conditions, snags, and logs would be managed to facilitate safe wildfire operations.
- The General Wildfire Protection Zone would replace the wildland-urban intermix threat zone of the current plan; it is irregular in shape, covering a larger area. This zone is based on modeling potential spread and intensity of wildfires that have a very high likelihood of burning toward and negatively impacting communities and assets as well as negatively impacting natural resources in the zone. The revised forest plan direction emphasizes active fuel reduction treatments along ridgetops, roads, and other natural and manmade features that can serve as strategic anchor points for larger prescribed burns and to create areas of low fuel that can be used to manage wildfires. Due to the high likelihood of wildfire occurring in this zone and possibly spreading into the community wildfire protection zone, wildfires would most often be suppressed to reduce the threat to communities and assets. In some instances, wildfires could be managed to meet resource objectives if environmental and fuel conditions allow and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and

direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management.

- The Wildfire Restoration Zone would be a new zone that identifies areas with low to moderate risk for communities and structures and other resource values. This zone is based on modeling potential spread and intensity of wildfires that can pose a mix of positive and negative effects to resources and some isolated assets. Thinning or prescribed burning may be needed before wildfires can safely be managed to meet resource benefits. Revised plan direction emphasizes active fuels management treatments in strategic locations to enable larger prescribed burns and to aid wildfire management that focuses on restoring fire to the ecosystem. Many wildfires in this zone would be managed to meet resource objectives under specific environmental and fuel conditions and when it could be done in a safe manner, although in some instances wildfires may be suppressed. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management.
- The Wildfire Maintenance Zone would be a new zone that identifies areas with very low risk. This zone is based on modeling potential spread and intensity of wildfires that pose mostly a positive effect to resources. The wildfire maintenance zone is typically in the higher elevations, wilderness, and remote areas where mechanical treatments are often not a management options, thus restoring the role of fire is important to achieve ecological sustainability. Most wildfires in this zone would be managed to meet resource objectives under specific environmental and fuel conditions and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management. Prescribed burning would be used here where it increases the opportunity to manage wildfires and restore fire-adapted ecosystems.

Managing Wildfire to Meet Resource Objectives

Revised forest plan direction would provide desired conditions and resource objectives that allow unplanned wildfire starts to be managed to meet resource objectives when it is safe to do so across the national forest. The conditions and opportunities to manage wildfires would vary by strategic fire management zone and plan direction would emphasize designing projects to reduce fuels in strategic locations to increase opportunities to manage unplanned wildfire starts in this way.

Smoke and Air Quality

Revised forest plan direction for prescribed fire and managing wildfires to meet resource objectives would emphasize considering the impacts of smoke locally and regionally.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Revised forest plan direction would incorporate the concepts of ecological restoration expressed in recent scientific publications such as “An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests” (North, Stine, O’Hara, et al. 2009) and “Managing Sierra Nevada Forests”

(North 2012b). The revised plan creates a management framework that allows an increase in the amount of restoration treatments using thinning, prescribed fire, and wildfires managed to meet resource objectives to make progress toward desired conditions across the landscape.

Revised plan direction would emphasize mechanical thinning and prescribed burning around communities and recreation areas and other forested areas. The revised plan increases emphasis on restoration of sagebrush ecosystems, especially to benefit the greater sage-grouse as described for "At-risk Species" on page 29.

Revised forest plan direction emphasizes treating along key roads and ridges and connecting natural openings like rock outcrops that can make it easier to implement larger prescribed burns and manage or suppress fires. Treatments would focus on drier sites near the roads and ridges where restoration would move vegetation toward desired conditions.

To address climate change, the revised forest plan includes desired conditions and direction for improving resilience to climate change in all vegetation types. In subalpine and alpine systems there is additional direction that focuses on the unique threats that these usually long-lived and slow-growing ecosystems (such as bristlecone pine) face as temperature and precipitation patterns change. The revised plan includes direction to manage for increased risk of insects and diseases and changed fire patterns and cycles in these ecosystems.

The revised forest plan added desired conditions for old forests, including the desired densities of large trees and large snags, and the desired proportion of the landscape that should be in old forest conditions. They include direction to increase the resilience of old forests and large or old trees to drought, climate change, and large, high-intensity wildfires, which acknowledges that the variation of forest types requires some flexibility in determining the best approach to improve resilience on the ground.

Complex Early Seral Habitat

The revised forest plan would include plan components to provide for key characteristics that are important to the ecological integrity of complex early-seral habitats after large fires or in large areas where trees have been killed by drought, insects, pathogens, wind or other events. This includes desired conditions for complex habitat characteristics, wide-spread distribution of snags, logs, and live trees, while considering the need for other resource objectives such as hazard tree removal, reforestation, and strategic fuel treatments.

Wildlife and Plant Habitat Diversity

The revised forest plan adopts the approach to species management of providing for ecological diversity and ecological integrity of habitat as the primary means to ensure the persistence of most species. Like the existing plan, the revised forest plan contributes to the recovery of federally listed threatened and endangered species and does not jeopardize proposed or candidate species, including the incorporation of relevant provisions of the "Draft Interim Recommendations for the Management of California Spotted Owl Habitat on National Forest System Lands" (USDA Forest Service 2015c) in the form of plan components.

Proposed objectives moderately increase restoration treatments to trend terrestrial habitat toward the desired conditions at a moderate pace. There is an increased emphasis on restoring fire as an ecosystem process in fire-adapted ecosystems with frequent fire-return intervals (in ponderosa and Jeffrey pine, and mixed conifer stands). Additional desired conditions for vegetation provides for increased habitat heterogeneity for multiple species at both the fine scale as well as at landscape scales. Specific desired conditions and guidelines for individual vegetation types, old forest, and sagebrush provide ecological integrity of habitat for multiple species. As a change from the draft plan, revised plan components have been included for invasive species that set standards and guidelines and establish goals to address working with other agencies, Tribes, and researchers.

Aquatic and Riparian Ecosystems

The revised forest plan identifies how the water, watershed, riparian conservation area, and conservation watershed direction are integrated and how the use of these components; restoration efforts; and monitoring provide an overall aquatic and riparian strategy for the Inyo National Forest. These elements work together to achieve desired conditions across the plan area.

Riparian Conservation Areas

Riparian conservation areas are designed to protect, restore, or enhance water quality and the ecological health and function of aquatic and riparian ecosystems and associated resources. These management area designations were based on the 2004 Sierra Nevada Forest Plan Amendment and the revised plan direction for riparian conservation areas is nearly identical to that contained in the existing plan, except for the following changes. The revised plan:

- Streamlines and consolidates direction that is similar in nature resulting in fewer plan components;
- Removes direction that repeats laws, regulations, or policies;
- Drops the term “riparian conservation objectives” because of the potential for confusion with plan component “objectives;” and
- Modifies direction to allow prescribed burn ignitions and, where necessary, mechanical and hand treatments to restore ecological integrity and improve the resilience of riparian ecosystems to fire, drought, and climate change.

Conservation Watersheds

Management of conservation watersheds emphasizes long-term prioritization for watershed maintenance and restoration to provide for persistence of species of conservation concern. Conservation watersheds are intended to be a network of watersheds that have been determined to have a functioning or functioning at-risk rating based on the Watershed Condition Framework; provide for connectivity and refugia for species of conservation concern; and provide high quality water for beneficial uses downstream. In conservation watersheds, long-term restoration and maintenance may occur over multiple planning cycles.

Considering public comments, best available science, relevant approaches on other national forests, and other species-specific conservation measures, we are removing management of current critical aquatic refuges and using conservation watersheds to reflect watersheds with a diversity of species of conservation concern. Even though critical aquatic refuges are no longer included in the revised forest plan, at-risk species will be managed either through plan direction or through policy, law, and regulations, including species conservation and recovery plans. Conservation watersheds benefit species found in them, providing better resilience and habitat connectivity in the face of large-scale disturbance.

There are many benefits of using conservation watersheds. Critical aquatic refuges sought to protect remnant species populations, and while important, our goal is to ensure species persistence, which could best be accomplished by ensuring habitat resiliency in the face of large-scale unpredictable events. Conservation watersheds provide well-distributed refugia for more species, and also create suitable ecological conditions across larger landscapes. Restoration goals were not explicit in critical aquatic refuges but they are explicit in conservation watersheds. Finally, developing a network of refugia among subbasins and establishing connectivity is a goal in the design of conservation watersheds.

Priority Watersheds

Priority watersheds are a short-term, geographically focused approach to restore all habitat types. Priority watersheds use restoration projects that could be completed within a 5- to 7-year period. Once completed, Inyo staff may shift restoration efforts to a new priority watershed. Priority watersheds may be designated within conservation watersheds to maintain or improve conditions.

Watershed Resilience to Climate Change

The desired conditions for aquatic and riparian ecosystems in the revised forest plan recognizes changes in temperature and precipitation related to climate change and other climate stressors on aquatic systems. Desired conditions are for restored vegetation conditions within watersheds, which in turn improves the quantity of water available to improve aquatic systems and to be available for other uses. Revised forest plan direction emphasizes improving watershed resilience to wildfire and climate change by treating vegetation and reducing fuels over larger areas to lower the intensity of wildfires. Restoration emphasizes thinning to reduce the effects of past management that has resulted in very dense forests, and mitigating impacts from unmaintained roads when they impair watershed function.

At-risk Species

The 2012 Planning Rule defines two categories for at-risk species: (1) species that are federally recognized threatened, endangered, proposed, and candidate species; and (2) species of conservation concern. Species of conservation concern are native, are known to occur in the plan area, and are species with a substantial concern for their capability to persist over the long term in the plan area. The 2012 Planning Rule requires plan components to provide the ecological conditions necessary to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area.

As part of the plan revision process, coarse-filter plan components such as desired conditions were developed that describe the desired outcomes and conditions for terrestrial vegetation, riparian habitats and features, and aquatic habitats and features within the Inyo National Forest plan area. For most at-risk species, meeting and maintaining these desired conditions and applying other standards or guidelines help provide the habitat and key ecological conditions to provide for their persistence and viability within the plan area. For a few species, additional species-specific plan components (desired conditions, standards, guidelines, and goals) were developed to better provide the habitats and key ecological conditions for persistence and viability within the plan area. This includes components for all “at-risk species.”

Based on public comment and more thorough analysis of best available science, the Regional Forester reevaluated the species of conservation concern list. Some species were added to the list while other species were removed from the Regional Forester's 2016 list. The latter was due to reevaluation of species occurrence in the plan area and the best available scientific information determined to be insufficient information to have substantial concern for the species capability to persist over the long term in the plan area. Species the Regional Forester added to the list include:

- Pacific fisher (*Pekania pennant*)
- California spotted owl (*Strix occidentalis occidentalis*)
- great gray owl (*Strix nebulosa*)
- Mt. Pinos sooty grouse (*Dendragapus fuliginosus howardi*)
- dune horsebrush (*Tetradymia tetrameres*)
- many-flowered thelypodium (*Thelypodium milleflorum*)
- rabbit-ear rockcress (*Boechera pendulina*)
- Virgate halimolobos (*Transberingia bursifolia ssp. virgata*)

The species removed from the previous list include:

- Fringed myotis bat (*Myotis thysanodes vespertinus*),
- Townsend's big-eared bat (*Corynorhinus townsendii townsendii*),
- American peregrine falcon (*Falco peregrinus anatum*),
- Sierra skipper (*Hesperia miriamae*),
- White Mountains skipper (*Hesperia miriamae longaevicola*),
- Atronis fritillary (*Speyeria mormonia obsidiana*),
- Denning's cryptic caddisfly (*Cryptochia denningi*),
- California sallfly (*Sweltsa resima*)
- Coyote gilia (*Alicia triodon*)
- Hidden rockcress (*Boechera evadens*)
- Alpine slender buckwheat (*Eriogonum microthecum* var. *alpinum*)
- Lake Tahoe serpentweed (*Tonestus eximius*)

The complete list of species of conservation concern identified by the Regional Forester for which the revised forest plan direction has been developed is described in the "Wildlife, Fish and Plants" section and in the rationale documents for animals and plants (USDA Forest Service 2018a, 2018b), including the reasons species were added or removed from the 2016 list.

Bi-State Greater Sage-Grouse

Species-specific plan direction is added for the bi-state greater sage-grouse on the Inyo National Forest. The proposed plan direction is based on the existing "Inyo National Forest Sage-Grouse Interim Management Policy (USDA Forest Service 2012c)" and, where appropriate, additional management direction has been developed consistent with the "Humboldt-Toiyabe National Forest Greater Sage Grouse Bi-State Distinct Population Segment Forest Plan Amendment." The revised forest plan also includes management direction and emphasizes management actions that are consistent with the "Bi-State Action Plan: Past, Present, and Future Actions for the Conservation of the Greater Sage-Grouse, Bi-State Distinct Population Segment."

California Spotted Owl

Species-specific plan direction for California spotted owl in the current plan provides for 300-acre protected activity centers designated around territorial locations intended to provide sufficient habitat to support nesting owls. This alternative replaces home range core areas with an one thousand acre circular territory surrounding the activity center to provide sufficient foraging and roosting habitat to support the home range needs of California spotted owls.

Great Gray Owl

Great gray owl is known to forage on the Inyo National Forest but there are no known nest sites. Great gray owl is a species of conservation concern on the plan area, but there are no species-specific plan components. There is a species-specific potential management approach to conduct additional surveys using established protocols to follow up reliable sightings of the owl.

Sierra Nevada Bighorn Sheep and Nelson Desert Bighorn Sheep

The revised plan direction is the same as the draft plan with clarifications related to disease risk from domestic livestock. The clarifications include: direction for continued use of a risk assessment approach, added direction to assess disease risk from recreational pack goats, and added direction to evaluate recreation impacts where potential conflicts to Sierra Nevada bighorn sheep are identified.

Yosemite Toad

Forestwide plan direction for at-risk species provides protection for Yosemite toad.

Rangeland Livestock Grazing

Forestwide grazing plan components are incorporated in the revised forest plan. These plan components are not changing from the 1988 Land and Resource Management Plan, Forest Plan Amendment 6 Forestwide Range Utilization Standards. Additional specifics of how the range utilization standards are determined can be found in appendix E of this document.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

During public comments on the draft environmental impact statement, the public emphasized the alternatives (alternatives B, C, and D) for sustainable recreation were insufficient, difficult to understand, and unclear as to what effect the direction would have on resources and uses. Some public comments suggested a zone approach to manage recreation and support sustainable use. We developed alternative B-modified to respond to the many comments we received from the public.

In alternative B-modified, the concept of recreation places in alternatives B, C, and D is replaced by a zone concept and incorporates the recreation opportunity spectrum. The result is a management approach that incorporates three different zones, which span a continuum from areas of more concentrated recreation to areas of remote, less-concentrated, low-density recreation. This approach focuses management where it is most intensely needed, and manages recreation differently from one place to another, based on a zone's particular resource needs. Within these zones, the landscapes would be managed for sustainable, balanced, multiple uses rather than for specific sites or places for specific types of use. This alternative provides a framework for future management actions with regards to recreation management and resource protection and works toward a sustainable balance among the three spheres of environmental, social, and economic conditions.

The recreation management zones are:

Destination Recreation Area – This zone provides the most developed recreation areas in the national forest. The public will find high-densities of recreation users with a variety of activities available. These areas emphasize facilities such as roads, parking lots, and restrooms. The recreation opportunity spectrum settings here are primarily roaded natural with some semi-primitive motorized and semi-primitive nonmotorized classes.

General Recreation Area – Multiple uses (beyond recreation) are most evident in this zone. These areas are working landscapes where fuelwood gathering, vegetation management, livestock grazing, electrical transmission infrastructure, geothermal, and mining may occur. Some landscapes may or will be modified to meet social, economic, and ecological objectives. The recreation opportunity spectrum settings are primarily rural, with a mix of semi-primitive motorized and semi-primitive nonmotorized classes.

Challenging, Backroad Recreation Area – This zone provides expanses of undeveloped landscapes suited for dispersed recreation. These are natural landscapes with few amenities, limited management, low visitor use, low density of visitors, and limited Forest Service presence. Motorized and nonmotorized recreation is often challenging due to terrain, and few roads and trails. The recreation opportunity spectrum settings are semi-primitive motorized, semi-primitive nonmotorized, and roaded natural classes to support remote recreation with little development.

Scenery

The revised forest plan direction identifies scenic integrity objectives for the plan areas using the Scenery Management System. Scenery setting management would be integrated with ecological integrity and restoration to improve scenic character stability within the desired landscape character. The revised forest plan includes plan components that require desired scenic integrity objectives be considered in the design of restoration projects.

Recommended Wilderness

Alternative B-modified would make a preliminary administrative recommendation to include four additional areas in the National Wilderness Preservation System (South Sierra; Piper Mountain Addition; White Mountains East; and White Mountains West). These are also referred to as "recommended wilderness areas." All four areas are adjacent to existing designated wilderness area boundaries and total 37,039 acres.

Pacific Crest Trail

The revised forest plan would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor of the visual foreground landscape zone (up to one-half mile from the centerline of the trail where visibility is not obscured by terrain) as defined by the Scenery Management System. Management area-specific desired conditions, standards, and guidelines and a management approach would be included to protect the nature, purposes, and resource values of the trail from degradation by activities and development.

Mono Basin National Forest Scenic Area

The revised forest plan includes desired conditions for the Mono Basin National Forest Scenic Area. These components were carried forward from the current area's comprehensive management plan into the revised forest plan and do not represent a change in plan direction.

Alternative C

Alternative C emphasizes wilderness values and a passive management approach to restore fire as an ecosystem process, primarily using prescribed fire and natural disturbance processes (such as managing wildfire for resource benefit) to achieve landscape-level desired conditions.

Alternative C was developed to address concerns about whether the forest plan provides adequate short-term protections for wildlife habitat. Like alternative B, alternative C includes plan components for conserving key characteristics associated with the ecological integrity for post-fire, complex early seral habitat. Also, additional critical aquatic refuges are identified around areas of high aquatic species diversity.

Revision Topic 1: Wildland Fire Management

Strategic Fire Management Zones

In alternative C, the fire management zones consist of a combination of existing plan direction and new zones created from the results of the wildland fire risk assessment. The distance-based wildland-urban intermix defense zone around communities would remain the same as in the existing plan. The maintenance zone is created using the same risk-based methodology used to create the wildfire maintenance zones as alternative B-modified and D. The general wildfire zone consists of the restoration zone, general wildfire protection zones, and portions of the community wildfire protection zone. The modifications in alternative B-modified to correct errors to highly valued resources and assets (HVRAs) and adjust potential wildland fire operational delineation units (PODs) were also applied when creating zones for Alternative C (see chapter 3, "Wildland Fire Management" section for more information and volume 3 for maps of the strategic fire management zones).

- Similar to the existing plan, the Wildland-Urban Intermix Defense Zone, closest to communities, would remain a high priority for hazardous fuel reduction treatment to reduce the intensity of wildfires in these areas. Maintenance treatments using prescribed fire instead of mechanical treatments would be the preferred management method whenever possible.
- The General Wildfire Zone consists of the wildfire restoration zone, general wildfire protection zone, and portions of the community wildfire protection zone. Wildfires that occur in the general wildfire zone where fuel conditions are close to desired conditions may be managed to meet resource objectives when environmental and fuel conditions allow and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management. There would be less strategic treatment using mechanical methods as a precursor to larger prescribed burns.
- Similar to alternatives B, B-modified, and D, the Wildfire Maintenance Zone in alternative C identifies areas with very low risk based on modeling potential spread and intensity of wildfires that pose mostly a positive effect to resources. In this zone, restoring the role of

fire is important to achieve ecological sustainability and most wildfires in this zone would be managed to meet resource objectives under specific environmental and fuel conditions and when it could be done in a safe manner. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and airmass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management. Prescribed burning would be used here where it increases the opportunity to manage wildfires and restore fire-adapted ecosystems.

Managing Wildfire to Meet Resource Objectives

Like alternatives B, B-modified, and D, alternative C would provide desired conditions and resource objectives that allow wildfires to be managed to meet resource objectives when conditions allow and it is safe to do so across the forest. The conditions and opportunities to manage wildfires would vary by strategic fire management zone, and plan direction for the wildfire maintenance zone would be the same as for alternatives B and B-modified. Species-specific plan direction to provide for habitat conditions for certain wildlife species would override direction for strategic treatments designed to increase the opportunity to manage wildfires to meet resource objectives.

Smoke and Air Quality

Alternative C would include the same guidance for designing projects to minimize the impacts of smoke on communities as alternatives B and B-modified.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Alternative C is designed to manage the forest landscape to minimize short-term impacts on habitats from management activities while accepting the risk of large high-intensity wildfires that could affect mature and old forests. Alternative C focuses vegetation and fuel reduction treatments within the wildland-urban intermix defense zone and seeks to restore vegetation desired conditions in the larger landscape with limited, strategic use of mechanical thinning and a heavier emphasis on the use of prescribed fire and wildfire managed primarily for resource objectives where safe and consistent with desired conditions. Alternative C would not use the focused landscapes approach described in alternatives B and D.

Like alternative B, alternative C adds desired conditions for old forests, including the desired densities of large trees and large snags, and the desired proportion of the landscape that should be in old forest conditions. It includes direction to increase the resilience of old forests and large or old trees important to wildlife habitats to drought, climate change, and large, high-intensity wildfires by restoring landscape heterogeneity that emulates patchy habitat that results from active, low- to mixed-severity wildfire.

Complex Early Seral Habitat

Like alternative B, alternative C would include plan components to provide key characteristics that contribute to the ecological integrity of complex early-seral habitats after large fires. However, alternative C would generally limit post-fire management to cutting burned trees that are a hazard to people and leaving them in place unless they pose a substantial hazard as downed logs. Direction in alternative C would vary from alternative B to leave most burned areas to recover naturally with no direct management action (no planting), even after very large fires. Where possible, efforts to treat half of the burned areas with prescribed fire would be planned 10 years after the initial fire to reduce accumulations of fuels and to maintain a frequent fire interval as a part of forest succession.

Wildlife and Plant Habitat Diversity

Desired conditions and other plan components for California spotted owl, Sierra marten, and Pacific fisher habitat would result in landscape conditions in the upper end of the moist mixed-conifer vegetation desired conditions. This is in contrast to alternatives B and D which would strive for desired conditions within the natural range of variation for all habitat types. Prescribed burning would be the preferred method of treatment.

Aquatic and Riparian Ecosystems

Proposed direction for riparian conservation areas and critical aquatic refuges is nearly identical to that contained in alternative B, with the following changes.

Critical Aquatic Refuges

Alternative C would add 8 new critical aquatic refuges on the Inyo National Forest. Management direction would be the same as in alternative B.

Watershed Resilience to Climate Change

Alternative C would differ from alternative B because it would not modify current direction to allow prescribed fire ignitions and, where necessary, mechanical treatments within riparian conservation areas. Alternative C would allow prescribed fire in riparian areas where it was historically prevalent to restore desired fuel conditions, to the extent it could occur with limited or no mechanical preparation.

At-risk Species

Alternative C emphasizes reducing the short-term consequences of restoration treatments to wildlife. For wildlife associated with old forests, as described in revision topic 1, it emphasizes retaining larger sized trees, minimizing reductions in forests with existing dense canopy cover, and retaining habitat elements such as high densities of large snags and downed logs, and retaining larger trees with cavities or deformities that can be used for nests or dens across the landscape.

Bi-State Greater Sage-Grouse

Species-specific plan direction would be added for the bi-state greater sage-grouse the same as alternative B, except the objective for acres of sage-grouse habitat maintained, improved, or restored would be increased slightly. This increase is due to less competition for funding resources with other ecological restoration projects as a result of increased restrictions on mechanical thinning.

Great Gray Owl

Direction for great gray owl is the same as alternative B-modified.

Sierra Nevada Bighorn Sheep and Nelson Desert Bighorn Sheep

Direction under alternative C would be the same as alternative B-modified.

Yosemite Toad

Species-specific proposed plan direction in alternative C for Yosemite toad would be the same as alternative A.

Willow Flycatcher

Alternative C would place an emphasis on maintaining and restoring nesting habitat for willow flycatchers in the Mono Lake Basin.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

The range of recreation opportunity spectrum classes would shift with larger areas allocated to primitive and semi-primitive nonmotorized recreation settings and less area allocated to motorized recreation settings in alternative C.

Scenery

Alternative C uses the same Scenery Management System as described in alternatives B and B-modified, the draft forest plan and the revised forest plan.

Recommended Wilderness

Alternative C would make a preliminary administrative recommendation to include 24 areas totaling 315,531 acres that would be recommended into the National Wilderness Preservation System. This would include nine areas (70,278 acres) adjacent to existing designated wilderness and 15 areas (245,253 acres) that are not.

Pacific Crest Trail

Alternative C would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor that includes the same visible foreground (up to one-half mile of centerline of the trail where visibility is not obscured by terrain) of alternative B and also includes lands inventoried as “Scenic Attractiveness A” in the Scenery Management System within the trail’s viewshed.

Alternative D

Alternative D includes an emphasis on an increased pace and scale of restoration in response to the issues of improving resilience to fire, drought, climate change, insects, and diseases, while enhancing economic and social sustainability. Like the draft forest plan, it emphasizes long-term habitat conservation, accepting that short-term impacts to species associated with dense forests would be offset by reducing the risk of habitat damage or loss from large high-intensity wildfire. However, alternative D eliminates diameter limits, and expands operating periods to allow more active management to move vegetation toward desired conditions more than the draft forest plan. It emphasizes additional mechanical treatment on strategic ridgetops, roads, and other natural and manmade features, and adjacent areas to increase the amount of landscape-scale prescribed burning to restore fire in the ecosystem.

Revision Topic 1: Fire Management

Strategic Fire Management Zones

Alternative D uses the same strategic fire management zones and similar direction as the draft and revised forest plans of alternatives B and B-modified. The modifications in alternative B-modified to correct errors to highly valued resources and assets (HVRAs) and adjust potential wildland fire operational delineation units (PODs) were also applied when creating zones for alternative D. (See chapter 3, "Wildland Fire Management" section for more information and volume 3 for maps of the strategic fire management zones.)

Managing Wildfire to Meet Resource Objectives

Alternative D uses the same approach as alternative B-modified to emphasize an increased management of wildfires to meet resource objectives when it is safe to do so. More areas are designed and treated using mechanical treatments and prescribed burning to create more opportunities to manage wildfires to meet resource objectives safely.

Smoke and Air Quality

The emphasis for managing wildfires to meet resource objectives would consider the impacts of smoke locally and regionally as in alternative B-modified. However, the additional opportunity for pre-treating areas prior to prescribed burning and additional focus areas treated to trend toward desired vegetation conditions would reduce the potential for community smoke impacts from uncharacteristic wildfire.

Revision Topic 2: Ecological Integrity

Terrestrial Ecosystems

Ecosystem Resilience and Adaptation to Climate Change

Alternative D is very similar to the draft forest plan (alternatives B and alternative B-modified) except it doubles the pace and scale of restoration to have a greater likelihood of reducing the impact of future high-intensity wildfires. It uses the same landscape strategies and approaches as the draft forest plan with the following changes:

- Alternative D emphasizes the strategic use of mechanical treatments where it is physically and economically feasible to facilitate greater management of wildfire to a greater extent than the draft forest plan—both the active use in prescribed burning at greater landscape scales as well as through managing wildfires to meet resource objectives when conditions allow and when it can be done in a safe manner. There is more emphasis on strategic treatment of ridgetops and along strategic road locations in the wildfire restoration zone that would facilitate more landscape prescribed burning and serve as anchor points for managing wildfires to meet resource objectives.
- On the Inyo National Forest, there would be more areas treated than in the draft plan.
- Like the draft forest plan, there would be more emphasis on providing variability within tree patches during treatments to increase heterogeneity and increasing resilience to drought.

Alternative D would manage old forests the same as the draft forest plan, focusing on increasing the resilience of existing areas with old forest conditions and emphasizing landscapes that meet desired composition of seral stages and include old forest components throughout.

Alternative D retains similar direction as the draft forest plan for the management of burned areas following a large fire, except it increases the emphasis on salvage for economic return and reforestation of portions of large fires that burn at high severity. This includes desired conditions for reforestation when needed to address sustainability of forests given the length of time it could take to reestablish forests dominated by large and old trees with natural reforestation, forest connectivity, and species composition and seed sources considering climate change.

Complex Early Seral Habitat

Like the draft forest plan, alternative D would include plan components to provide for the key characteristics that provide for the ecological integrity of complex early seral habitats after large fires. This includes desired conditions for complex habitat characteristics, wide-spread distribution of snags, logs, and live trees while considering the need for other resource objectives such as hazard tree removal, reforestation, and strategic fuel treatments. Alternative D would emphasize economic recovery of burned forest while still contributing to desired conditions for this habitat.

Wildlife and Plant Habitat Diversity

Alternative D incorporates the same direction regarding at-risk species as the draft forest plan; however, plan direction emphasizes restoring enough area across the landscape to increase climate adaptation, and reduce the risk of large, high-intensity wildfires to important at-risk wildlife species habitat, while also continuing to manage a portion of the landscape as high-quality habitat for at-risk species. This alternative accepts some short-term risk to species to manage more areas for vegetation desired conditions to provide for greater sustainability of habitats over time. Alternative D focuses on the long recovery time for habitats of many at-risk species and is designed to lessen the rate of habitats adversely affected by large high-intensity wildfires. Restoration treatments would occur at an increased level sufficient to trend terrestrial habitat toward the desired conditions at a moderate to high pace.

Aquatic and Riparian Ecosystems

Critical Aquatic Refuges

Alternative D includes the same direction for riparian conservation areas and critical aquatic refuges as the draft forest plan.

Watershed Resilience to Climate Change

Alternative D incorporates the same aquatic management strategy direction as the draft forest plan. Maintenance and restoration would occur on more roads due to the increased area of restoration treatments and increased stewardship opportunity. Restoration would emphasize reducing the legacy effects of past management that continue to degrade watershed function, especially reducing or eliminating sediment risks from roads and restoring hydrologic connectivity of habitat for amphibians and fish.

At-risk Species

Plan direction for species of conversation concern would be the same as the draft forest plan.

Bi-State Greater Sage-grouse

Like the draft forest plan, species-specific plan direction is added for the Bi-state greater sage-grouse, except the objective for acres of sage-grouse habitat maintained, improved, or restored is increased the same as alternative C. This increase is due to increased stewardship funding opportunities and an increase in landscape-scale restoration treatments overall.

California Spotted Owl

This alternative is the same as alternative B-modified.

Great Gray Owl

Direction for great gray owl in alternative D is the same as alternative B-modified.

Sierra Nevada Bighorn Sheep and Nelson Desert Bighorn Sheep

The direction for alternative D for Sierra Nevada and Nelson Desert bighorn sheep would be the same as alternative B-modified and alternative C.

Yosemite Toad

The standards and guidelines that exclude livestock grazing within areas occupied by Yosemite toads during the breeding and rearing season, except where a site-specific management plan is developed would change to a new system to determine appropriate management strategies. In the new system, either a known Yosemite toad occupied site, designated critical habitat, or the results of an empirically derived occupancy probability model would be used in combination with meadow habitat conditions to guide a matrix of grazing management strategies. These strategies would range from no grazing to the current forestwide grazing standards in the existing forest plan.

Revision Topic 3: Sustainable Recreation and Designated Areas

Sustainable Recreation

In alternative D, the range of recreation opportunity spectrum classes would shift with fewer areas allocated to primitive and semi-primitive nonmotorized recreation settings and more area allocated to motorized recreation settings. Improvements in recreation settings would be associated with larger treatment areas to improve landscape resilience to fire and climate change rather than emphasizing treatments around individual sites and infrastructure.

Scenery

Alternative D uses the same Scenery Management System as described for the other plan revision alternatives.

Recommended Wilderness

Alternative D would not make any additional preliminary administrative recommendations to the National Wilderness Preservation System.

Pacific Crest Trail

Alternative D would create a management area allocation for the Pacific Crest National Scenic Trail by defining a corridor one-quarter mile from the centerline of the trail. The plan direction assigned to the corridor would be the same as the draft forest plan.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by the National Environmental Policy Act to rigorously explore and objectively evaluate reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received during the plan revision process provided suggestions for the proposed revised plan. Some of these suggestions may not have been part of identified needs for change, were duplicative of the alternatives considered in detail, or were determined to contain components that would cause unnecessary environmental harm.

A number of alternatives were considered, but dismissed from detailed consideration for reasons as summarized in the following paragraphs.

Eliminated Alternative 1: Restore over half of the landscape within 10 to 15 years

An alternative was suggested that uses substantially more active vegetation management including thinning, selective harvest, and prescribed fire to restore forest resilience to fire, drought, insect and pathogen outbreaks, and climate change as quickly as possible. This alternative was not considered in detail because it would require more workforce and budget than is feasible for the agency given budgets received in recent years. More than half of the landscape on the Inyo National Forest is within special designated areas such as wilderness, monuments or wild and scenic river corridors that limit or prohibit the use of mechanical equipment. Another 25 percent of the national forest has limitations on roaded access, such as inventoried roadless areas, which limit getting equipment into areas as well as making it difficult to transport staff or workers into these areas by motor vehicles.

There are areas of particularly steep grades where restoration using equipment can be difficult as it must be designed to avoid causing unacceptable ecological damage due to accelerated erosion risks. There are other areas where sensitive ecological conditions and endangered species exist, which requires restraint and caution in how much treatment can occur and how quickly. Scientific knowledge is continuing to provide new insights into the biology of at-risk species in these forests and there is a concern about balancing rapid change in habitat from active management with changes in habitat that may occur without treatment in terms of the consequences to wildlife.

Another limitation to rapid restoration related to forest thinning is the capacity of industry to do the work and use materials. Currently there is a limited infrastructure to process the timber resulting from restoration efforts. If restoration outpaces infrastructure capacity, then the Forest Service costs increase and the agency’s capability to fund restoration will decrease. Therefore, there is a limitation on the capability of the Forest Service to restore forests that is directly related to the limited capacity of the industry infrastructure.

The alternatives being considered increase the use of prescribed fire over current levels and recognize there are limits imposed by air quality restrictions, current forest conditions and forest capacity and resources to conduct more prescribed burning. Smoke and its impact on the health of rural communities is also a concern and can be a limitation on the number and acres and timing of prescribed burning.

One of the identified needs for plan revision is “to improve recreation facilities, settings, opportunities and access and their sustainability.” Although it is true that rapidly addressing landscape restoration will contribute toward long-term recreation sustainability, during the time of rapid restoration there would be a great impact on recreation and the recreation experience, whether it would be from more smoke or fire on the landscape from prescribed fire, more crews and big trucks, or closed and restricted access to campgrounds while tree cutting and equipment operations are going on. The proposed level of restoration would limit the ability to meet the purpose and need for recreation as access and recreation opportunity would be substantially diminished during the plan period.

Alternatives B and D increase the amount of restoration but the amount would still affect only about 20 to 40 percent of the treatable portions of the national forest per decade. The amount of restoration accomplished by managing wildfires to meet resource benefits would increase this, but it is entirely dependent upon actual wildfires that can only be estimated and not planned. It is expected that this pace may adjust in the future if capacity for active management increases.

Eliminated Alternative 2: Include all areas identified by the public as recommendations for additions to the National Wilderness Preservation System

The responsible official and interdisciplinary team considered an alternative that would recommend as wilderness all areas evaluated, or identified by the public. This alternative was dismissed from detailed analysis for two reasons:

1. The Forest Supervisor determined that it would be impracticable to manage such a vast wilderness area.
2. The impacts to other uses of the lands would be greater than the benefits provided by the additional wilderness area. Specifically, recommending all evaluated areas as wilderness would conflict with the identified need for change described in Revision Topic 3, “There is a need to provide sustainable and diverse recreation opportunities that consider population demographic characteristics; reflect desires of local communities, avoid overcrowding and use conflicts, and minimize resource damage; protect cultural resources.”

Detailed rationale addressing each evaluated or publically identified wilderness polygon is in appendix B. The following discussion addresses the overarching reasons that the Forest Supervisor dismissed from further consideration an alternative that would include all of these polygons.

Context

Currently, 46 percent of the Inyo National Forest is in designated wilderness. Recommending additional wilderness areas in the revised plan would prohibit and further geographically constrain certain management activities and uses. Specifically, the Wilderness Act states that, “there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.”

Background

Various groups and individuals submitted feedback specific to the wilderness inventory and evaluation processes, suggesting additional areas that should be included in the preliminary administrative recommendations for additions to the National Wilderness Preservation System. These areas were considered during the inventory and evaluation following the 2012 Planning Rule and associated implementation directives as described in appendix B. For more information, see Issue 6 in the Public Participation section of chapter 1.

The Forest Supervisor used the wilderness evaluation narratives and public input to identify which specific areas, or portions thereof, to carry forward into the draft environmental impact statement analysis in one or more alternatives as recommended wilderness. Although many areas suggested by the public were brought forward for analysis in alternatives B and C, not all lands included in the inventory or suggested by the public were analyzed in detail. Generally, areas not analyzed in detail:

- Lacked wilderness characteristics;
- Had substantially noticeable human impacts;
- Represented a departure from apparent naturalness due to improvements;
- Had pervasive impacts that would influence a visitor’s opportunity for solitude including pervasive sights and sounds from outside the area; or
- Were determined to be unmanageable to preserve their wilderness characteristics.

In particular, areas with motor vehicle designations from recent travel management decisions were considered but then excluded from polygon boundaries carried forward for analysis in the draft environmental impact statement. See appendix B for the full description of the inventory, evaluation, and analysis processes and findings.

What Wilderness Provides

Wilderness provides many benefits to those who enjoy recreating in these areas. The purpose of the Wilderness Act is, “to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, … to secure for the American people of present and future generations the benefits of an enduring resource of wilderness.” It defines wilderness areas as:

- where the earth and its community of life are untrammeled
- undeveloped Federal land retaining its primeval character and influence
- without permanent improvements or human habitation
- protected and managed so as to preserve its natural conditions

It specifically states that wilderness:

1. generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
2. has outstanding opportunities for solitude or a primitive and unconfined type of recreation;
3. has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and

4. may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Wilderness Management Challenges and Trade-offs

Education, Recreation Management, and Law Enforcement

The Wilderness Act specifies these lands, "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness." The Inyo National Forest currently has just two backcountry rangers to cover approximately 1 million acres of land. This limits the opportunity for visitor contact to inform, educate, and regulate activities, as appropriate. Additionally, with substantial acreage already allocated to wilderness, trail maintenance and development is challenging. It is especially difficult for forest staff to rebuild major damage to trails because of the lack of roaded access, and the inability to use motorized or mechanized equipment.

The Inyo National Forest already has a documented problem with motorized incursion into wilderness, based on law enforcement contact. The Inyo recorded 51 incidents of wilderness trespass with a motorized vehicle, and one with a bicycle, from 2010 through 2016. These incidents were recorded as "ongoing" meaning there was evidence of more than one occurrence of trespass at a particular site, such as tire tracks, or vandalized blocking installations. Much of this trespass occurs in areas that are within 100 feet of highways, or adjacent to towns and ski areas. In many cases, the wilderness trespass was unintentional—the entirety of wilderness boundaries can't be marked, and users are often unaware of the location, existence, or rules of wilderness.

Vegetation, Fire, and Wildlife Habitat Management

Wilderness designation does not preclude vegetation and fuels management, but it does make most of the usual management tools unavailable. Therefore, large-scale fuels treatments and forest habitat restoration activities would be significantly reduced, and timber production activities would not occur in areas recommended for wilderness. When wildfires start or burn into wilderness, again, the tools available to manage those fires are limited. Fire managers are able to work with these limitations, but they require a different approach from wildfire response in areas not recommended or designated as wilderness.

A major wildlife habitat management issue on the Inyo National Forest is pinyon pine encroachment on sage-grouse habitat. An existing agreement between the Forest Service and the Fish and Wildlife Service emphasizes conifer removal as an important management tool to restore sage-grouse habitat and avoid listing this species under the Endangered Species Act. Ongoing, large-scale management of conifer encroachment in sagebrush would be not be possible in recommended wilderness areas.

Several areas evaluated for wilderness, or proposed by the public, currently contain guzzlers—artificial, human-built water sources for wildlife. There is a community of hunters and wildlife enthusiasts on the Inyo National Forest who maintain these as a way to support and increase animal populations. Guzzlers would have to be removed from designated wilderness areas, as they are an "imprint of man's work."

Other Uses and Considerations

Existing Wilderness

With nearly half of the acreage of the Inyo National Forest already in wilderness, the areas of the national forest that best fit the definition of wilderness are generally already designated as such. Appendix B shows the reasons that each polygon suggested was not recommended. In large part, the rationales there state that opportunities for solitude and primitive recreation are limited in the suggested polygons, mostly because they contain, or are adjacent to roads or motorized trails.

Existing Transportation System

The table below depicts the mileage of system roads, motorized trails, and unauthorized routes in the polygons considered for wilderness in the four alternatives, and in the total wilderness inventory and evaluation. This alternative considered, but eliminated, would remove access to as many as 3 miles of system roads, 261 miles of motorized trails, and 294 miles of unauthorized routes. If all wilderness areas evaluated were recommended, 73 percent of the motorized trails on the Inyo National Forest would no longer be available.

Managing wilderness areas that previously contained many miles of motorized routes would be a major challenge. Additionally, the motorized use community, which has commented on this analysis, as well as on the Inyo National Forest's 2009 Travel Management Plan have requested that we reevaluate unauthorized routes not added to the transportation system in the travel planning process. Wilderness recommendation would preclude the addition of these routes to the motorized road and trail systems. The Inyo National Forest provides a relatively unique opportunity for backcountry motorized recreation, much of which would no longer be available if all evaluated polygons were to be recommended as wilderness.

Special Uses and Facilities

Within the polygons evaluated but not recommended as wilderness, there are approximately 28 facilities managed by the Los Angeles Department of Water and Power. Southern California Edison, Pacific Gas and Electric, U.S. Geological Survey, and other agencies and universities also manage facilities or conduct research in these polygons. These entities would no longer have driving access to their facilities and research sites if all suggested or evaluated polygons were to be recommended as wilderness. In some cases, the facilities and research projects would be unmanageable without motorized access.

Tribal Uses

Several Tribes commented on the wilderness evaluation, concerned about tribal uses that would no longer be possible if the polygons were to become recommended wilderness. Tribal members, and especially elders, access areas for hunting, gathering, and engaging in other heritage activities, by motor vehicle. Elders pass cultural heritage and knowledge of particular areas of the forest to younger generations. Many elders are not able to walk long distances, especially while carrying collected plants or animals. Additionally, some heritage activities may not be permissible if they leave an "imprint of man's work" in recommended wilderness areas.

Grazing

Grazing is culturally important in the area of the Inyo National Forest and, according to Inyo County, it is also important to the local economy. Of the 52 grazing allotments on the Inyo National Forest, 45 have some portion within or touching the wilderness evaluation polygons. Grazing is not prohibited in wilderness, but the cost and difficulty of managing grazing is higher in wilderness areas. Many local grazing operations are already marginal, and may not be economically viable with any additional expense. It is also more difficult for Forest Service staff to manage grazing allotments that are not accessible by motor vehicle, and where motorized and mechanized tools are not allowed. This may mean fewer visits to, less oversight of, and generally less management and maintenance on allotments once they are in recommended wilderness.

Specific Recreation Activities

If all evaluated areas were recommended as wilderness on the Inyo National Forest, two additional recreation activities could be affected: climbing and mountain biking. Fixed anchors are not allowed in wilderness, and the majority of the climbing community uses these. Mountain climbing is a major draw to the Bishop, California area, and a part of its identity. It provides substantial economic value through tourism and equipment provision.

Within wilderness evaluation polygons on the Inyo there are 151 miles of nonmotorized trails. These are generally open to mountain biking. However, bicycles are considered “mechanized” equipment, and therefore prohibited in wilderness areas. Mountain biking is less significant than climbing, in terms of community identity and economic value in the area of the Inyo National Forest, but it does still contribute to the recreation portfolio. The mountain biking and climbing communities have commented about the reduction in their opportunities if more areas of the forest were to be recommended wilderness.

Conclusion

Because of the management challenges, trade-offs, and use conflicts described above, the responsible official concluded that an alternative recommending all polygons evaluated as wilderness was not feasible, did not respond to a need for change, and should not be analyzed in detail.

Eliminated Alternative 3: Identify critical aquatic refuges around all areas of high aquatic species diversity

An alternative was suggested that identifies 15 areas of high aquatic species diversity on the Inyo National Forest and recommended these areas be delineated and managed as critical aquatic refuges. These areas were evaluated by staff and all but 7 areas were included in at least one alternative considered in detail. Areas not included were because they were either a proposed expansion that would not substantially increase the habitat protection of the existing critical aquatic refuges, were located primarily on lands owned or managed by others, or were already within watersheds that are a priority for maintenance or restoration. The evaluation of each area recommended for consideration as a critical aquatic refuge is included in the project record. Since these additional proposed critical aquatic refuges would not increase habitat protection, including all of them in an alternative would have substantially similar effects as alternative C and therefore adding them as part of an alternative was not necessary.

Eliminated Alternative 4: Evaluate an alternative that has minimal active management and “let nature take its course”

An alternative was suggested that has minimal active management of vegetation and allows nature to take its course in shaping the vegetation and conditions in the national forest. It was suggested that wildfires would reduce built up fuels and regenerate forests while creating early seral habitats for species that depend upon them. It was also suggested that natural mortality would thin weakened trees leaving more resources for the remaining trees and vegetation.

However, this type of “hands-off” approach is contrary to the best available science that recommends restoration efforts for many of the ecosystems that are outside their natural range of variation. Alternatives B, C, and D address long-term vegetation health in the desired condition statements of how the various vegetation types on the Inyo National Forest should look and function. Management action is necessary to trend these ecosystems toward the desired conditions and strengthen ecosystem resilience in the face of expected climate changes in the western United States.

This alternative also would not meet the requirements of the 2012 Planning Rule, which requires plans to be developed that are ecologically, socially, and economically sustainable. This alternative also would not achieve various aspects of the purpose and need. For example, this alternative would not:

- improve ecosystem resilience to fire and climate change;
- decrease the threat of large, undesirable fires;
- increase the ability of forests to store and sequester carbon;
- improve ecological conditions for the California spotted owl and restore and maintaining greater sage-grouse habitat on the Inyo National Forest;
- support local economies by maintaining levels of forest product and biomass production that support an economically-viable forest products industry, and encourages local hiring;
- support economic opportunities in tribal communities; incorporate traditional ecological knowledge; and increase collaboration with the agency to meet restoration goals; or
- improve recreation facilities or improve and protect scenic character.

Because this alternative is not in alignment with the best available science of the best methods of achieving desired conditions and it does not meet the stated needs for revision it was not analyzed in detail.

Eliminated Alternative 5: Apply the Aquatic Conservation Strategy from the 2001 Sierra Nevada Forest Plan Amendment

An alternative was suggested that requested the revised plans incorporate the aquatic conservation strategy from the 2001 Sierra Nevada Forest Plan Amendment (USDA Forest Service 2001c) as plan direction. The fundamental principle of the 2001 Sierra Nevada Forest Plan Amendment aquatic management strategy was “to retain, restore, and protect the processes and landforms that provide habitat for aquatic and riparian-dependent organisms, and produce and deliver high-quality waters for which the national forests were established.” For the aquatic management strategy to function as a comprehensive strategy there are a suite of interrelated actions that work together to manage and conserve aquatic habitats. These actions include:

- a description of the desired condition of aquatic, riparian, and meadow habitats developed from the aquatic management strategy goals;
- an array of land allocations (such as critical aquatic refuges and riparian areas) that delineate aquatic, riparian, and meadow habitats and emphasize specific actions in these areas;

- a set of standards and guidelines that specify appropriate land uses and activities within different land allocations;
- ecosystem analysis that enables managers to collect and evaluate relevant data and information over nested geographic zones (such as watersheds within river basins) for the purpose of considering current landscape conditions and results in appropriate, site-specific management decisions, including restoration of degraded areas; and
- an adaptive management program that includes monitoring and research activities intended to assess planned management activities and provide information needed to adjust future management activities, as appropriate.

The 2001 Sierra Nevada Forest Plan Amendment aquatic management strategy was incorporated into the 2004 Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004d), which amended the existing forest plan with only a few changes directed at clarifications and simplifications to eliminate repetition of law, regulation, and policy in forest plan direction. These changes were analyzed in the 2004 Sierra Nevada Forest Plan Amendment, which is the current plan. The current plan is analyzed in detail (alternative A), and therefore, the essential components of the original 2001 aquatic management strategy are analyzed.

Eliminated Alternative 6: Consider the document “National Forests in the Sierra Nevada: A Conservation Strategy” as an alternative

A group of respondents submitted a Conservation Strategy for National Forests in the Sierra Nevada with the request that it be analyzed as an alternative in detail. The Conservation Strategy contains several concepts and strategies related to sustainability and resilience of forests within the Sierra Nevada. Some of these concepts are already in place under the current forest plans (such as community fire planning, various collaborative efforts, and completion of travel analysis), some will be incorporated into the planning process and documents (such as a science consistency review will be conducted before the final environmental impact statement is prepared), and others are largely consistent with the draft forest plan. In most instances where the draft forest plan is not in agreement with the Conservation Strategy, concepts and direction similar to those in the Conservation Strategy are included as part of another alternative (C or D) that was analyzed in detail.

The Multiple Use Sustained Yield Act[16] states “it is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes.” Similarly, the 2012 planning regulations require that plans “provide for social, economic, and ecological sustainability.”[17] This is accomplished by including plan components, including standards and guidelines, “to guide the plan area’s contribution to social and economic sustainability.”[18] While the Conservation Strategy would meet many of the requirements for ecological sustainability, it does not adequately meet the requirements of the Multiple Use Sustained Yield Act or the Planning Rule requirements for social and economic sustainability because it does not include plan components for sustainable recreation, range, timber and other renewable and nonrenewable energy and mineral resources.

[16] Public Law 86-517

[17] 36 CFR 219.8

[18] 36 CFR 219.8 (b)

For these reasons, we concluded that a detailed analysis of an alternative based on the Conservation Strategy was not needed.

Eliminated Alternative 7: Allow existing motorized and mechanized uses to continue in recommended wilderness

Public feedback on the recommended wilderness inventory and evaluation asked the Forest Service to consider an alternative that allowed existing motorized and mechanized recreation activities to continue in recommended wilderness areas. Although Forest Service policy does allow decisionmakers to consider allowing existing uses to continue, they can do so "only if such uses do not prevent the protection and maintenance of the social and ecological characteristics that provide the basis for wilderness designation."[19] Cole and Hall (Cole 2010) found that by controlling the setting (environmental, social, and managerial conditions), managers influence the nature and quality of [wilderness] experiences to a substantial degree.

The use of motorized and mechanized transportation in recommended wilderness areas affects the wilderness characteristic of undeveloped settings where wilderness is essentially without permanent improvements or modern human occupation. In addition, the use of motorized and mechanized transport is not compatible with the desired condition of a primitive recreation opportunity, which, specifically in designated wilderness, has largely been interpreted as travel by horse, foot, and canoe (Landres et al. 2005). Also the presence, volume, and type of other users and the sounds and smells associated with motorized vehicles can affect solitude.

Some national forests have taken a management approach to allow motorized and mechanized transportation to continue in recommended wilderness areas as long as the ecological and social characteristics are protected and maintained. This requires monitoring of a number of factors including level of existing use at the time of recommendation, levels of use over time (increase, decrease, or neutral), and the effects of the continued use on wilderness character over time. This is a challenging monitoring effort in a fiscally constrained environment.

Because of the potential impacts to wilderness character, which may prevent the protection and maintenance of the social and ecological characteristics that provide the basis for future wilderness designation, and the difficulty of monitoring continued motorized and mechanized uses in recommended wilderness, this alternative was eliminated for detailed analysis.

Comparison of Alternatives

This section compares how the alternatives are different with respect to the issues to be resolved and their key indicators and management areas. In addition, forest plan objectives are also compared across alternatives.[20]

Comparison of Management Areas by Alternative

Table 1, table 2 and table 3 describe management areas or designated areas applicable by alternative. In alternative A, areas with specific plan components were called land allocations, which is the equivalent to the 2012 Planning Rule definition for a management area. The management areas for wilderness, wild and scenic rivers, and the Pacific Crest National Scenic

[19] Forest Service Handbook 1909.12, chapter 74.1

[20] Note: For the Sequoia National Forest, all tables in this section refer to the portion of the national forest outside of the Giant Sequoia National Monument.

Trail are also designated areas. Table 1 indicates which other designated areas occur. Some management areas such as wilderness, wild and scenic rivers, and the Pacific Crest National Scenic Trail are also designated areas included in the table.

Table 1. Management areas by alternative

Management Area	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Wildland-urban Intermix Defense Zone (acres)	21,940	Not applicable	Not applicable	21,940	Not applicable
Wildland-urban Intermix Threat Zone (acres)	191,616	Not applicable	Not applicable	Not applicable	Not applicable
Community Wildfire Protection Zone (acres)	Not applicable	170,572	116,146	Not applicable	116,146
General Wildfire Protection Zone (acres)	Not applicable	371,596	559,513	Not applicable	559,513
Wildfire Restoration Zone (acres)	Not applicable	568,685	533,233	Not applicable	533,233
General Wildfire Zone (acres)	Not applicable	Not applicable	Not applicable	1,155,557	Not applicable
Wildfire Maintenance Zone (acres)	Not applicable	872,106	774,070	805,462	774,070
General Forest - “Other”	1,769406	Not applicable	Not applicable	Not applicable	Not applicable
Designated Wilderness (acres)	967,039	967,039	967,039	967,039	967,039
New Recommended Wilderness (acres)	0	37,029	37,029	325,359	0
Designated Wild and Scenic Rivers (miles)	90	90	90	90	90
Existing Recommended Wild and Scenic Rivers (miles)	16.5	16.5	16.5	16.5	16.5
Eligible Wild and Scenic Rivers (miles)	128.3	241.2	241.2	241.2	241.2
Pacific Crest National Scenic Trail (miles)	86	86	86	86	86
Pacific Crest National Scenic Trail Corridor (acres)	116	39,973	39,973	130,350	22,053
Critical Aquatic Refuges (acres)	170,600	191,567	0	322,518	191,567
Conservation Watersheds	0	0	387,678	0	0
Challenging Backroad Area (Low Use)	0	0	543,938	0	0
General Forest Recreation Area (Mixed/Moderate Use)	0	0	327,622	0	0
Destination Recreation Area (High Use)	0	0	45,585	0	0

Table 2. Summary of alternatives by revision topic

Revision Topic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Fire Management	Management focuses hazardous fuel reduction treatment in two distance-based areas surrounding the wildland-urban intermix defense zone and wildland-urban intermix threat zone. Naturally ignited wildfires are evaluated on a case-by-case basis to determine if they can be managed to meet resource objectives.	Replaces alternative A zones with four management areas based on a fire risk assessment consistent with the National Cohesive Fire Strategy: community wildfire protection zone, general wildfire protection zone, wildfire restoration zone, and wildfire maintenance zone. Strong emphasis on managing naturally ignited wildfires in the wildfire maintenance zone and strongly encouraged in wildfire restoration zone where some mechanical and burning treatments may be needed first.	Same as alternative B except errors were corrected to highly valued resource and assets (HVRAs) and made adjustments to the potential wildland fire operational delineation units (PODs), both variables used in the wildland fire risk assessment. The changes in HVRAs included correcting data errors in the asset HVRAs, defining the California Spotted Owl HVRA, removing the northern goshawk HVRA, and removing the visual resource HVRA. POD boundaries were remapped to include contiguous areas of low elevation sagebrush. POD level adjustments were made to assign the final zone classification to general protection rather than restoration or maintenance. Emphasis on managing naturally ignited wildfires to achieve resource objectives for resource benefits same as alternative B.	Fire management zones consist of a combination of alternative A distance-based wildland-urban interface defense zone and the alternative B risk-based wildfire maintenance zone. The remainder of the Inyo would be called the general wildfire zone. The modifications in alternative B-modified to correct errors to HVRAs and adjust PODs were also applied when creating zones for Alternative C. Emphasis on managing naturally ignited wildfires in the wildfire maintenance zones same as alternative B. In the general wildfire zone, naturally ignited wildfires strongly encouraged but prescribed burning may be needed first.	Fire management zones and approach to managing naturally ignited wildfires same as alternative B. The modifications in alternative B-modified to correct errors to HVRAs and adjust PODs were also applied when creating zones for alternative D.

Revision Topic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Ecological Integrity – Vegetation management	Management emphasis on short-term retention of mature forest habitat for old forest associated wildlife species. Vegetation and fuels management treatments prioritized in the wildland-urban intermix and elsewhere in a roughly geometric pattern of strategically placed area treatments. In the wildland-urban interface defense zone (the area closest to structures and communities), there are fewer restrictions on the intensity of thinning. There is a forestwide standard and guideline limiting tree removal to less than 30 inches in diameter.	Management emphasis on restoration of vegetation desired conditions based on natural range of variation and habitat elements for at-risk species. Treatments continue to reduce fire risk near communities. Strategically located mechanical and prescribed burning treatments along roads and ridges are designed to support larger landscape-scale prescribed burning and greater opportunity to manage wildfires to meet resource objectives. Forestwide direction for limiting removal of trees larger than 30 inches in diameter applies to the wildfire restoration zone and wildfire maintenance zone. Elsewhere, desired conditions for number of large trees by vegetation type guides retention levels.	Similar to alternative B except 133,490 acres (7% of total acres in the plan area) will be reclassified from Maintenance or Restoration Fire Management Zone to the General Wildfire Protection Zone. Nearly all these acres are located in lower elevations of the sagebrush vegetation type, where the primary restoration approaches will rely on methods other than wildfires managed to achieve resource objectives. Some adjustments also made to account for infrastructure. Forestwide direction for limiting removal of trees larger than 30 inches in diameter clarified to allow some removal for ecological restoration and to benefit old forest conditions. Use of fire to meet desired conditions provides direction for managing long-term functionality of aquatic, riparian, and terrestrial systems in conservation watersheds and also provides flexibility with the intent to increase the pace and scale of restoration in riparian areas, meadows, and streams.	Mechanical treatments are focused on the wildland-urban interface defense zone, with limited mechanical treatment elsewhere. There is an emphasis on prescribed burning as the primary restoration method and an emphasis on managing wildfires to meet resource objectives where feasible. Forestwide direction for limiting removal of trees larger than 30 inches is same as alternative A except in the portion of the Inyo with California spotted owl habitat where smaller diameter limits exist in suitable habitats.	Management emphasis is similar to alternative B but there is more focus on increasing the area treated to improve the long-term sustainability and resilience of forests and watersheds. Desired conditions for number of large trees by vegetation type guides retention levels forestwide. There are no diameter limits for removing large trees.

Revision Topic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Ecological Integrity- aquatic and riparian resources (critical aquatic refuges, conservation watersheds and riparian conservation areas)	Identifies riparian conservation areas, a buffer area around streams, rivers, lakes, meadows, bogs, and other wetland types. The riparian conservation area is wider for perennial streams than for intermittent and ephemeral streams and can be adjusted smaller or larger based upon site conditions. Prescriptive standards and guidelines avoid, minimize or mitigate activities and actions that could adversely affect riparian vegetation or aquatic conditions. Identifies a set of 17 critical aquatic refuges focused on areas with threatened and endangered species or areas of other species with population concerns. The direction that applies to riparian conservation areas applies to the critical aquatic refuges.	Direction is functionally similar to that contained in alternative A, except for: a) streamlining and consolidating direction; b) removal of direction that repeats laws, regulations, or policies; c) changing “riparian conservation objectives” from Sierra Nevada Forest Plan Amendment to other plan components for consistency with 2012 Planning Rule requirements; and d) modifying the direction to allow prescribed burn ignitions and, where necessary, mechanical and hand treatments to restore ecological integrity. One additional critical aquatic refuge would be added to the 17 in alternative A.	Similar direction for riparian conservation areas as alternative B with some clarification, refinements, and reorganization. Switches approach of managing 17 small scattered critical aquatic refuges that provide for aquatic species with approach managing 4 larger conservation watersheds. Conservation watersheds are a subset of watersheds that are prioritized to provide for persistence of both plant and animal at-risk species (biodiversity focus) as well as other beneficial uses of water. Because of their scale, they provide cumulative beneficial effects on connectivity, integrity, and refugia for at-risk species in the face of large-scale unpredictable events.	Direction for riparian conservation area and critical aquatic refuges would be the same as alternative B. Adds 8 new critical aquatic refuges to the 17 in alternative A.	Alternative D includes the same direction for riparian conservation areas and critical aquatic refuges as alternative B.

Revision Topic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Ecological integrity – wildlife	Plan direction for management of federally listed species and Regional Forester designated sensitive species. Limited forest plan direction for management of sagebrush and sage-grouse habitat. Management guided by agreements to implement direction in interagency action plans. Direction for forest management primarily focused on the short-term retention of dense canopy cover and restricts removal of large trees to provide mature forest habitat for species like the California spotted owl and Sierra marten.	2012 Planning Rule manages for at-risk species, which are federally listed species and species of conservation concern. Species of conservation concern are designated by the Regional Forester and replace Regional Forester sensitive species. Adds specific forest plan direction focused on restoration of sage-grouse habitat The Draft EIS alternative mistakenly dropped plan direction for California spotted owl and great gray owl. The Final EIS corrects this error and applies the same plan direction developed for the Sequoia and Sierra National Forests in the Draft EIS for alternative B but limits it to the same spatial area on the Inyo National Forest as in alternative B-modified.	The at-risk species approach is the same as alternative B. Modifies some of the strategic fire management zones from alternative B to reclassify areas dominated by sagebrush to the general wildfire protection zone to limit impact of fire on sage-grouse habitat. (Fire suppression of most fires in sagebrush helps prevent cheatgrass invasion.) Refines the plan direction for California spotted owl from alternative B to reflect the limited amount of suitable habitat adjacent to the Sierra and Sequoia National Forests. Modifies plan direction for the great gray owl from alternative B to drop direction for pre-defined protected activity centers to allow establishment of necessary protective measures based upon other forestwide direction for at-risk species.	The at-risk species approach is the same as alternative B. Increased restoration of sage-grouse habitat similar to alternative B. Retains emphasis on short-term habitat protection for California spotted owl and Sierra marten in forested habitats by applying the same direction developed for the Sequoia and Sierra National Forests for alternative C to the same limited area as alternative B.	Same as alternative B.
Recommended Wilderness	No additional recommended wilderness areas	Makes a preliminary administrative recommendation to include 4 additional areas in the National Wilderness Preservation System (South Sierra; Piper Mountain Addition; White Mountains East; and White Mountains West); 37,029 acres.	Same as alternative B	Alternative C would make a preliminary administrative recommendation to include 24 additional areas totaling 325,352 acres in the National Wilderness Preservation System.	No additional recommended wilderness areas

Revision Topic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Wild and Scenic River Eligibility	Includes current inventory of 128.3 miles of wild and scenic rivers.	The updated miles determined to be eligible for inclusion in the National Wild and Scenic Rivers System is approximately 241.2 miles.	Same as alternative B.	Same as alternative B.	Same as alternative B.
Pacific Crest Trail	The current forest plan manages the Pacific Crest Trail according to direction provided by a 1982 Comprehensive Management Plan and direction is focused on the trail tread and immediate surroundings Width of management area is 6 feet.	Creates a management area allocation for the Pacific Crest Trail by defining a corridor of the visual foreground landscape zone as defined by the Scenery Management System, (up to one-half mile from the centerline on both sides of the trail where visibility is not obscured by terrain). Width of management area is up to one-half mile of each side of centerline.	Creates a management area and sets direction the same as in alternative B.	Creates a management area allocation for the Pacific Crest Trail by defining a corridor that includes the same visible foreground (up to one-half mile of centerline of the trail where visibility is not obscured by terrain) as alternative B and also includes lands inventoried as “Scenic Attractiveness A” in the Scenery Management System within the trail’s viewshed. Width of management area up to 4 miles each side of centerline of trail.	Creates a management area allocation for the Pacific Crest Trail by defining a corridor one-quarter mile from the centerline of the trail. The plan direction assigned to the corridor would be the same as alternative B. Width of management area one-quarter mile each side of centerline.
Scenery Management	Scenic character is managed using the 1986 Visual Management System.	Identifies scenic integrity objectives for the plan areas using the Scenery Management System.	Same as alternative B	Same as alternative B	Same as alternative B

Revision Topic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Sustainable Recreation and Recreation-based Management Areas	The emphasis is on improving recreation opportunities by focusing on the maintenance, development, adaptation, or alteration of dispersed and developed recreation sites consistent with the recreation opportunity spectrum class of the area.	Recreation opportunity spectrum classes are updated to reflect existing management and to consider recommended wilderness. The management approach for recreation settings is integrated with ecological restoration approaches. A concept of "places" is used to guide management efforts to sustain scenery, settings and opportunities.	The concept of recreation places in alternatives B, C, and D is replaced by a zone concept and integrates with the settings described by the recreation opportunity spectrum. The three zones span a continuum from areas of more concentrated recreation to areas of remote, less-concentrated, low density recreation.	Similar to alternative B except the range of recreation opportunity spectrum classes would shift based on recommended wilderness areas.	Similar to alternative B except the range of recreation opportunity spectrum classes would shift with fewer areas allocated to primitive and semi-primitive nonmotorized recreation settings and more area allocated to motorized recreation settings due to recommended wilderness.
Production Livestock Grazing	Grazing direction includes 1988 Forest Plan and 1995 Forest Plan Amendment 6 – Forestwide Range Utilization Standards. Amendment 6 references some outdated methods and includes process and protocols for determining allowable grazing utilization standards as part of forest plan direction.	Several updates to existing management direction as compared to Alternative A. Amendment 6 (1995) removed from forest plan. Process and protocols would be located in a technical guide residing outside the plan called "Forest Supplement to Rangeland Analysis and Planning Guide." [2012 planning rule guidance suggests methodologies for assessment processes not be included in plan content.	Same as Alternative B	Same as Alternative B	Same as Alternative B
Timber Suitability	85,025 acres suitable for timber production	72,234 acres suitable for timber production	Same as alternative B	70,608 acres suitable for timber production	Same as alternative B

Table 3. This table represents a brief summary of consequences for the major topics addressed in this final environmental impact statement

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Agents of Change Combined effects of climate, fire, insects, and pathogens	Relatively low to moderate restoration treatment rates will somewhat reduce the combined impacts of climate change, fire, insects, and pathogens, but only in a limited number of treated areas within the larger landscape. Conservation of moderate to high-density canopy cover in late seral forest habitat would result in low resilience to high-intensity fires, drought and temperature increases.	Moderate restoration treatment rates will reduce the combined impacts of climate change, fire, insects, and pathogens in more areas than in alternative A. Treated forest, sagebrush, and pinyon juniper ecosystems will have enhanced capacity to resist the interactive effects of multiple stressors. This alternative emphasizes climate adaptation strategies across larger landscapes.	Similar to alternative B but with a marginally lower combined impact of climate change, fire, insects, and pathogens due to slightly higher restoration treatment rates.	Similar to alternative A, but with greater resilience to combined stressors resulting from higher fire restoration (prescribed fire, wildfire managed for resource objectives) treatment rates.	Similar to alternative B but has greater amount of restoration treatment across the landscape, resulting in the lowest combined impacts of climate change, fire, insects, and pathogens. Treated forest, sagebrush, and pinyon juniper ecosystems will have a higher capacity to resist the interactive effects of multiple stressors.
Wildland Fire Management	Does not proactively analyze fire risk with a spatial risk assessment, which limits the restoration and maintenance of landscapes through managing wildfire to meet resource objectives, and the safe and effective fire responses due to the uncertainty of the location of assets and resource at risk. This results in limits to the restoration and maintenance of landscapes through the use of wildfire, both with strategically located prescribed burning and wildfires managed to meet resource objectives.	Risk assessment provides information that reduces uncertainties and allows forest and fire managers to have more latitude to proactively plan and restore the landscape by managing wildfire to meet resource objectives and using prescribed fire. Applies risk management explicitly and has the greatest amount of ecological restoration that reduces risk and provides resource benefits. This greater amount of projects and the enhancement of strategic fire management features would provide the greatest likelihood of implementing large prescribed fires or managing wildfires to meet resource objectives.	Same as alternative B, but there is a reduced amount of low elevation sagebrush in the Wildfire Restoration Zone. Instead, most low elevation sagebrush is changed to the General Wildfire Protection Zone. This will reduce the negative impacts of wildfires on sagebrush where expansion of cheatgrass is a risk.	This alternative uses a more simplified 3-zone approach that will make it more difficult and uncertain to make fire management decisions that minimize the negative impacts of wildfires on high-valued resources and assets (HRVAs). This alternative emphasizes the use of prescribed fire and limits mechanical treatment of medium and large conifers for vegetation management. This could limit the amount of projects and the enhancement of strategic fire management features to meet resource objectives.	Same as alternative B-modified.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Air Quality	Increases in emissions and other cumulative effects would make long-term attainment of emissions goals unlikely under alternative A.	Restoration activities would increase emissions and affect air quality in the short term, but the degree of increase is dependent on the amount of treatment. In the long-term, restoration activities would reduce emissions from wildfires.	Same as alternative B	Same as alternative B except emissions, given the focus on managed and prescribed fire for restoration, would have the potential for higher expected short-term emissions. To the extent that prescribed burning and wildfires managed to meet resource objectives occur, a reduction in wildfire smoke would make long-term attainment of visibility goals more likely than under alternative A but less likely than under alternatives B-modified, B and D.	Same as B except, given the highest pace and scale of restoration activity, in the long-term alternative D has the greatest potential to reduce emissions from wildfires. The restoration treatments would result in the greatest reduction in wildfire emissions. This alternative has the greatest likelihood of long-term attainment of visibility.
Terrestrial Ecosystems Sierra Nevada zones and habitats	Fewer opportunities for restoration including use of wildfire to achieve resource objectives results in slower return to desired conditions than in the plan revision alternatives.	Somewhat higher restoration rates across larger landscapes primarily through increased use of wildfire to meet resource objectives. Results in better adaptive capacity, but large high-intensity fire is likely to continue. There will be moderated effects in treated landscapes.	Same as alternative B	Increased emphasis on prescribed fire and wildfire managed for resource objectives, which may result in increased restoration. Because of lower level of mechanical treatment in these habitat types, there may be fewer opportunities to manage wildfire for resource objectives.	Similar to alternative B except with greater rates of restoration toward desired conditions in vegetation structure and composition.
Terrestrial Ecosystems Great Basin zones and habitats	Lower rates of restoration than the plan revision alternatives and slower to achieve desired conditions across these habitat types.	Increased rates of treatment compared to the current plan would move these habitat types toward desired conditions across the landscape. Main effects would be to achieve less dense and more heterogeneous structure, and reduce nonnative invasive plants. These changes would increase the resilience to drought, insects and pathogens, climate change, and fire.	Same as alternative B	There would be greater mechanical restoration treatment rates in sagebrush than in alternatives B and B-modified. Great Basin habitats other than sagebrush would only have slightly more restoration than in the current plan and would be slower to reach desired conditions.	Given the higher pace and scale of restoration, this alternative would be expected to move the greatest amount of sagebrush shrublands toward the desired conditions, especially in areas of sage-grouse habitat. Other Great Basin habitats, like pinyon-juniper, would progress toward desired conditions at a slightly higher rate than under alternative B.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Terrestrial Ecosystems Landscape Connectivity	Provides low to moderate connectivity for forest-associated and other wildlife species under both short- and long-term horizons. Alternative A promotes lower restoration treatment rates and lacks some management approaches that are specifically focused on habitat linkage and dispersal corridor areas.	Provides for moderate levels of short- and long-term habitat connectivity, especially for forest-associated species such as marten. Includes a greater number of management approaches focused on maintaining habitat linkages than alternative A.	Same as alternative B	Provides the greatest short-term connectivity but at the cost of higher exposure or sensitivity to uncharacteristically severe fire, climate change, and other stressors that reduce long-term habitat connectivity.	Supports somewhat greater long-term habitat connectivity than alternative B, but at the cost of significantly reduced short-term habitat connectivity resulting from elevated mechanical and prescribed fire treatment rates in the next 10 to 20 years.
Terrestrial Ecosystems Old Forest	Same as alternative B except there would be slightly lower levels of benefit from restoration because treatments would be less intense and less extensive.	There would be slightly more old forests restored to desired tree densities, heterogeneity, tree canopy cover, fire regime integrity, and fire as an ecosystem process. This would restore old forests toward conditions reflecting the natural range of variation. In treated areas, large, old trees would have substantially increased resilience to moisture stress, drought, insects and pathogens, ozone, and large, high-intensity fires. There would also be reduced vulnerability to future drought, insect, and pathogen-related large tree mortality because the greatest intensity of forest thinning across large areas and greater levels of fire restoration would occur.	Same as alternative B	Same as alternative B except there would be slightly lower levels of benefit from restoration because treatments would be less intense and less extensive.	Same as alternative B except there would be somewhat higher restoration treatment rates and associated expected benefits to old forest structure and resilience.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Terrestrial Ecosystems Complex Early Seral Forest	There is a low to moderate increase in complex early seral forest in alternative A. The proportion of complex early seral forest will be slightly higher than the natural range of variation.	There is a moderate increase in complex early seral forest that is greater than alternative A but less than alternative C. Specific plan components in alternative B provide for greater protection of complex early seral forest. The proportion of complex early seral forest will be more similar to natural range of variation than alternative A.	Same as alternative B	The increase in complex early seral forest would be the highest in alternative C. The proportion of complex early seral forest may be within or exceed the natural range of variation in some forest landscapes.	Same as alternative B
Aquatic and Riparian Ecosystems	Management direction does not explicitly address climate change. Riparian conservation areas provide ecological connectivity across larger landscapes. Proposes the fewest number of meadows maintained, enhanced or improved and has more restrictive constraints on use of restoration tools. There would continue to be limited restoration of riparian vegetation and limited ability to adequately reduce fuel volumes in riparian conservation areas. As a result, aquatic habitat under this alternative would be at a greater risk to degradation from untreated stressors and large-scale disturbances.	This alternative addresses ecological connectivity, species diversity and resilience to climate change more explicitly and includes direction that will help reduce fuel loads, restore fire, and manage riparian vegetation species composition, structure, and function, while reducing soil disturbance. Direction emphasizes desired conditions and management of riparian conservation areas to provide flexibility of management using a variety of tools. More meadows would be maintained, enhanced or improved than in alternative A. Restoration activities create a fire regime more aligned with historic patterns, thus improving riparian area resilience to fire.	Same as Alternative B, but incorporates a larger landscape approach by using conservation watersheds. It replaces 17 critical aquatic refuges (typically 10,000-40,000 acres each) with four conservation watersheds (typically larger than 80,000 acres) in areas prioritized for conservation of at-risk species, their habitats, and headwaters providing high-quality water for beneficial uses. Complementary approach among riparian conservation areas, conservation watersheds, and forestwide direction for at-risk species and watersheds provides protections and allows latitude and flexibility to increase the pace and scale of restoration in riparian areas, meadows, and streams.	Alternative C adds 8 critical aquatic refuges. It would have fewer disturbances to the riparian conservation areas than alternatives B and D with more restrictions on mechanical treatments overall. Maintains, enhances or improves more meadows than alternative A and would move vegetation toward desired conditions and reduce the ingrowth of conifers.	Similar to alternative B except that the high number of treatments proposed translates into a higher risk of short-term disturbance to aquatic species and temporary disturbance to aquatic habitat conditions from mechanical and prescribed fire treatment actions until the habitat recovers.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Water Quality and Quantity, and Watershed Condition Water Quality	No change in current management direction and therefore continued trends in water quality are expected.	Emphasizes a long-term approach through increased pace and scale of ecological restoration across the landscape and reduces the overall risk of high-intensity wildfire. Short-term impacts would be similar to alternative A because riparian conservation areas would be carried forward and best management practices would minimize these impacts.	Same as alternative B.	Similar to alternative B in effects except alternative C includes more recommended wilderness, and therefore would use less mechanical pre-treatments. As a result, restoration activities may not be applied to the extent needed, which could lower long-term benefits to water quality compared to other plan revision alternatives.	Same as alternative B except that alternative D best reduces the overall risk of high-intensity wildfire over the long-term, thus potentially providing the most long-term benefits.
Water Quality and Quantity, and Watershed Condition Water Quantity	Would likely maintain shallow groundwater at current levels if not for the changing climate trending toward warmer and drier conditions in the Sierra Nevada. Even if precipitation remains the same, more rain and less snow would reduce recharge and storage and increase runoff. Combined with greater evapotranspiration, the precipitation provides less soil moisture for healthy forest vegetation, soil infiltration, and recharging the shallow groundwater.	Would reduce evapotranspiration at a landscape scale and would likely increase the opportunities for infiltration across many watersheds.	Same as alternative B	Same as alternative A	Same as alternative B

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Water Quality and Quantity, and Watershed Condition Watershed Conditions	Would take longer to restore the fire regime and forest health at a landscape level.	Alternative B would move the national forest towards desired conditions at a faster pace than alternatives A and C through restoration of fire regimes and improving forest health at a landscape level. Long-term water quality and quantity are closely linked to these indicators.	Similar to alternative B. In addition, conservation watersheds represent a long-term prioritization for maintenance and restoration of watersheds and particularly focus on aquatic resources and water quality. This alternative will maintain and in some cases improve the functional rating of some Watershed Condition Framework indicators such as but not limited to, fire regime, wildfire, water quality, and riparian/aquatic habitat over the long term. Restoration of fire regimes and restoring forest health at a landscape level would be achieved at a faster pace than alternatives A or C.	Same as alternative B but would take longer than to restore fire regime and forest health at a landscape level.	Alternative D restoration treatments would provide benefits to maintaining water and soil quality and watershed condition over the long term as compared to the other alternatives. Alternative D would increase the pace and scale of acres of riparian vegetation improved and meadows restored compared to alternative A. The pace and scale is similar to alternatives B and B-modified for restoration of fire regimes and restoring forest health.
Wildlife, Fish and Plants At-risk Terrestrial Species	Continues to manage federally listed species through project-level consultation and consideration of recovery actions in approved recovery plans. Manages for Regional Forester sensitive species through project-level design and analysis of consequences. Continues to manage limited amounts of sagebrush habitats for sage-grouse through project level actions identified in the Bi-State Action Plan. Has the most limited ability to mitigate the continuing increase in large, high-intensity wildfires and build	Stronger emphasis on coordination with U.S. Fish and Wildlife Service and CA Department of Fish and Wildlife for implementing species protection and recovery than alternative A. Stronger protection for Sierra Nevada bighorn sheep reduces the risk of disease transmission. Manages for species of conservation concern through combination of ecosystem and some species-specific plan components to provide ecological conditions and reduce impacts from threats. More sagebrush habitats improved for sage-grouse than alternative A.	Effects similar to alternative B for federally listed species. Consequences for species of conservation concern similar to alternative B. Emphasis on sagebrush restoration similar to alternative B, but strategic fire management zones changed to recognize foothills sagebrush as general wildfire protection zone where most fires will be suppressed to protect sagebrush habitats. Similar to alternative B in the pace and scale to restore resilience at a large landscape scale.	Effects similar to alternative B for federally-listed species. Substantially increases the amount of sagebrush restoration, but some mechanical restoration may be slightly more difficult to implement with new recommended wilderness in the Glass Mountains. Direction allows some non-conforming uses for restoration to be allowed in recommended wilderness. Similar to alternative A in the limited ability to mitigate the continuing increase in large, high-intensity wildfires and build adaptive capacity of ecosystems to climate change. Alternative C is	Effects similar to alternative B for federally-listed species. Amount of sagebrush restoration for sage-grouse the same as alternative C but not as restricted using mechanical treatments in the habitats near the Glass Mountains. Similar to alternative B except that the pace and scale of restoration proposed under alternative D is expected to more quickly achieve resilience of the landscape to large-scale disturbances (such as insect outbreaks, high-severity wildfire effects, and drought-related tree mortality), thereby providing a greater long term benefit to

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
	adaptive capacity of ecosystems to climate change. Therefore, presents a greater risk to the quantity and condition of habitat to contribute to the recovery of threatened and endangered species, conservation of proposed species, and support the persistence of species of conservation concern.	Alternative B is designed to achieve desired conditions in less time than alternative C by focusing on restoring large landscapes using a variety of tools, decreasing the expected amount of crown fire and moving high-severity fire effects toward natural range of variation. The treatment pace and scale is expected to move the landscape to moderate fire resilience within the first 10 years of plan adoption. Alternative B provides a more cautious approach than alternative D by tempering the pace of restoration. Habitat for these species would continue to be at risk due to large, high-intensity wildfires.		better than alternative A at addressing climate change.	terrestrial wildlife habitat quantity and condition. However the management approach has greater potential for short-term impacts to achieve improved habitat condition.
Wildlife, Fish and Plants At-risk aquatic species	Limited implementation of restoration is expected to leave many areas containing native at-risk aquatic species vulnerable to impacts like sedimentation from large uncharacteristic fires.	Expanded direction related to invasive species should benefit aquatic species across all plan revision alternatives. While the negative effects of large-scale wildfires are expected to be significantly reduced, the increased pace of treatments translates into a higher risk of short-term disturbance to aquatic species and habitat conditions from mechanical and prescribed fire treatment actions until the habitat recovers. In the long term, the direction is expected to improve the resilience of the overall landscape to wildfire, result in more long-term	The emphasis in this alternative is building larger landscape-scale resilience to unpredictable events, to help species adapt. Connectivity in this and all alternatives is achieved through riparian conservation areas, and in this alternative through conservation watersheds provides increased upland connectivity for species. Additional direction to provide for at-risk species has been added where needed to complement the landscape scale approach. Direction focuses on restoration aimed to maintain or improve connectivity and refugia.	The additional critical aquatic refuges are intended to provide species protections but their management direction is restrictive, which could affect pace and scale of restoration in habitats important for at-risk aquatic species.	The emphasis on low- and medium-intensity fires across the landscape would improve long-term potential for improved habitat for aquatic species. Short-term impacts from mechanized treatments from ground-disturbing activities would be likely on the aquatic systems but it is expected there would be long-term benefits to these habitats.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
		beneficial effects to aquatic species, and better promote the long-term sustainability of aquatic habitats and greater ability of these habitats to adapt to climate change.			
Wildlife, Fish and Plants At-risk Plant Species	The current forest plan for the Inyo National Forest does not include direction calling for the development of a whitebark pine conservation and restoration strategy. Inyo manages for whitebark pine as a sensitive species. Provides the necessary ecological conditions to maintain viable populations of plant species of conservation concern by relying primarily on project-level surveys and mitigations of adverse effects.	Restoration activities aimed at maintaining a viable population of whitebark pine would provide for the persistence of that species. Species monitoring from the regional ecology program would assist with developing management strategies. Alternative B would have more beneficial short- and long-term effects for whitebark pine than alternative A, due to the emphasis on forest restoration. Provides long-term benefits to plant species of conservation concern habitat extent and quality, resulting from ecological and hydrologic restoration, invasive species control, recommendation of wilderness that would protect some species of conservation concern plants, and from the emphasis on ecosystem resilience to climate change. Would also provide for persistence of plant species of conservation concern that occur in special habitats and address identified threats to special habitats.	Similar direction to alternative B (very minor editorial changes). Restoration effects are similar to alternative B. Some potential for more impacts in destination recreation areas but design of projects still emphasizing conservation of species.	Same as B-modified.	Same as B-modified

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Sustainable Recreation Recreation development and visitor use	Does not provide an integrated and adaptive approach to managing and operating sustainable recreation facilities, protecting sensitive resources or managing visitor use. Potential negative impacts to visitor expectations and experiences would be the highest without responding to visitor conflict, crowding, or changing uses.	Increased restoration activities means all plan revision alternatives provide greater potential to improve long-term sustainability of recreational opportunities and settings (even with short-term impacts). This alternative more effectively addresses recreation development than alternative A, but does not provide specific direction for an integrated and adaptive approach. Visitor use will continue to increase and because direction is based on recreation opportunity spectrum alone, but approach would be less adaptive. Visitor experiences and expectations could be negatively impacted without specific direction that prioritizes where staff manages visitor use and facilities.	Designation of Sustainable Recreation Zones provides direction to effectively manage recreation development in a changing environment. It recognizes there will be new and changing uses; and it uses an adaptive and integrated approach to designing and managing recreation infrastructure while protecting resources. Sustainable Recreation Zones provide the most benefits to managing visitor use and ensuring quality visitor experiences and expectations would be met while protecting natural and cultural resources. Visitor use would be managed adaptively to prevent impacts to other resources.	Same as alternative B	Same as alternatives B and C
Recommended Wilderness Potential effects on recreation settings and opportunities, access, and recreation management	No impact to existing motorized or mechanized (mountain bike) opportunities; however, without new wilderness recommendations, there would not be additional long-term social or ecological benefits derived recommendations, and no increase in wilderness recreation opportunities for nonmotorized users.	No impact to existing motorized or mechanized (mountain bike) opportunities; however, wilderness additions would limit future development of mountain bike and off-highway vehicle opportunities. There would be expanded wilderness recreation opportunities for nonmotorized users seeking backcountry day-use and overnight opportunities.	Same as alternative B	The most beneficial to nonmotorized recreation opportunity settings. Some existing mountain bike use would be affected where recommended wilderness areas include existing mechanized trails. Would have greatest impact to limiting future development of mountain bike and off-highway vehicle opportunities.	The trade-off to the increased pace and scale of restoration activities is that there would not be additional long-term social and ecological benefits in the absence of recommending new wilderness areas. These lands could be susceptible to uses that would be incompatible with wilderness designation if kept in the existing management status, even though currently managed as inventoried roadless areas.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Recommended Wilderness Potential effects on vegetation, fire, wildlife habitat, and watershed management	A full suite of management tools would be available to conduct fuels, fire management, and restoration activities; however, without recommending wilderness areas, there would not be additional social and ecological benefits.	Large-scale fuels treatments and restoration activities would be more limited in areas recommended for wilderness; however, the ecological and social benefits of adding adjacent wilderness areas would outweigh the management challenges of conducting fuels and vegetation management activities. The impacts of managing sage-grouse habitat on wilderness character would be minimal given the small amount of habitat inside the wilderness addition.	Similar to alternative B, except there would be beneficial effects to Cottonwood-Crooked Creek Headwaters Conservation Watershed in the proposed White Mtn. east and west additions. Future development would be prohibited, which would maintain the watershed condition rating of relevant indicators.	The challenges of managing habitat for sage-grouse and conducting other restoration activities would outweigh the potential ecological benefits in this alternative due to the large amount of recommended wilderness acres recommended. A lack of restoration activities due to these management challenges could ultimately put resources at risk within recommended wilderness.	A full suite of management tools would be available to conduct fuels, fire management, and restoration activities at an increased pace and scale; however, there would not be additional ecological or social benefits derived from recommending wilderness areas.
Recommended Wilderness Potential effects on other uses	No adverse impacts would occur since no wilderness would be recommended.	No adverse impacts to water rights, water uses, grazing, Tribal uses, or mining claims since these uses would be allowed to continue in recommended wilderness. The tradeoff would be that wilderness recommendation could increase the cost and complexity of maintaining facilities or uses because of the need to use nonmotorized access and nonmechanized means of maintenance. As a result, the annual operating costs for these uses would have the potential to increase. The extent of potential cost increases is uncertain at programmatic level. Management of recommended wilderness would prohibit access by motorized vehicle and mechanized equipment for	Same as alternative B	Same as alternative B, but annual operating costs would have the potential to increase to the greatest extent under alternative C due to greater amounts of recommended wilderness. The extent of potential cost increases is uncertain at programmatic level.	Same as alternative A

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
		maintenance of stock water developments, salt placement and potentially restrict installation of new range improvements (water troughs) and could increase costs for ranchers.			
Recommended Wilderness Wilderness Character	No impacts since no new wilderness recommended	The impacts of managing sage-grouse habitat on wilderness character would be minimal given the small amount of habitat inside the addition.	Same as alternative B	Would likely be impacts to wilderness character from restoration activities required to adequately maintain sage-grouse habitat and conduct other restoration activities, which would likely impact the untrammeled quality of wilderness character because conifer removal and prescribed fire activities would be evident, at least for short-term periods.	No impacts since no new wilderness recommended
Pacific Crest National Scenic Trail Corridor	No changes	Provides protection for the resources, qualities, values, and associated settings and primary uses of the Pacific Crest National Scenic Trail. No system roads or trails are proposed to be closed or changed in management or use on trail related to the Pacific Crest Trail Corridor. Since there are no existing permits for recreation events on the Pacific Crest Trail, there would be no displacement of permittees. The prohibition of new events would decrease the potential for displacement of and conflict with the primary Pacific Crest Trail users, hikers (including individual trail runners) and equestrians. Three miles of the Pacific Crest Trail	Same as alternative B	Same as alternative B but given the number of acres in the management area, provides the most protection for the resources, qualities, values, and associated settings and primary uses of the Pacific Crest National Scenic Trail.	Same as alternative B

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
		outside of wilderness would be closed to recreation events. Recreation events could occur on the remaining 587 miles of trails outside of wilderness on the Inyo.			
Forest Products	Would continue management at current levels of mechanical treatments, with limited improvements in forest health and resilience to disturbance agents and climate change at the project (stand) level. Landscape resilience would continue to decline.	Could potentially increase pace and scale of mechanical treatments from the existing conditions, incrementally improving forest health and resilience to disturbance agents and climate change. Would increase fuelwood availability.	Same as alternative B	Would decrease the pace and scale of mechanical treatments from the existing conditions thereby decreasing forest products production; however, small improvements in forest health and resilience would be expected to occur in the short term at the project (stand) level, similar to alternative A.	Would increase pace and scale of mechanical treatments from the existing conditions, improving forest health and resilience to disturbance agents and climate change. However, the absence of infrastructure may limit achievement of desired objectives. Would increase fuelwood availability.
Production Livestock Grazing	Gradual improvement in ecological conditions in allotments likely to continue in this and the plan revision alternatives based on current direction.	Modernizes current direction and analysis procedures (now found as a technical guide outside of the plan) to provide modest improvements in riparian conservation areas and resilience to disturbance and climate change at the allotment level.	Same as alternative B	Same as alternative B	Updates same as alternative B. There would be no effects related to recommended wilderness.
Economic Conditions	The continuation of current management activities in the face of current resource conditions (such as vegetation) and trends is expected to result in more disruptive events, such as uncharacteristic wildfire, and additional declines in forest health. This could have adverse short- and long-term effects on economic benefits to local communities, and could affect opportunities in terms of recreation and other economic benefits.	Alternative B would have long-term beneficial effects on economic conditions in local communities and on the Inyo National Forest. In the short term, there is the potential for disruption to some of these benefits from increased activities.	Same as alternative B	Alternative C would have some long-term beneficial effects on economic conditions in local communities and on the Inyo's benefits to people's lives. However, there is a long-term loss of the opportunities for developing local biomass industries as a result of this alternative.	Would be similar to alternative B. The increased pace and scale of restoration could potentially provide even greater benefits; however, it could also lead to potential increases in the short-term adverse effects resulting from these restoration activities.

Resource	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Social Conditions	Contributes to sustaining a diverse set of forest-related values in the long term, but is not as integrated as the plan revision alternatives.	Supports a diverse set of forest-related values in the long term through increased ecological restoration that moves forest conditions closer to ecosystem desired conditions and fire-resilient landscapes. By moving toward these desired conditions, aesthetic, biodiversity, cultural, economic, learning, recreation, and well-being values are sustained over the long term.	Same as alternative B	Values are more at risk to negative impacts over the long term given limited ecological restoration treatments.	Same as alternative B.

Chapter 3.
Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the physical, biological, social, and economic environments of the plan area and the potential environmental consequences that may occur in those environments by implementing each alternative. It also presents the scientific and analytical basis for the comparison of alternatives presented in chapter 2. In some cases where indicated, more detailed information, including methodology, assumptions, and effects analyses, can be found in the specific resource supplemental report located in the planning record located at the Pacific Southwest Regional Office, Vallejo, California.

The Relationship between Forest Plans and Site-specific Activities

The focus of this analysis is to examine the implications or longer term environmental consequences of managing the Inyo National Forest under the programmatic framework provided by the draft revised forest plan and alternatives. Forest plans do not authorize, fund, or carry out any project or activity described in the effects analyses. Instead, they provide a programmatic framework that guides site-specific actions that may be carried out in the future.

Because a land management plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. The draft forest plans set the stage for what future management actions are needed to achieve desired outcomes (for example, desired conditions and objectives), and provide the sideboards (such as suitability, standards, and guidelines) under which future activities may occur to manage risks to ecological, social, and economic environments. The draft forest plans also identify potential management approaches that may be used to help achieve desired conditions. To actually plan and proceed with a site-specific project, project-level planning, environmental analysis, and decisions must occur. (For example, the forest plan contains direction to thin vegetation and reduce fuels to benefit ecosystem resilience; however, a subsequent site-specific analysis and decision must be made for each proposal that involves vegetation treatment or fuel reduction activity in a chosen area).

Science and Assumptions Used in the Environmental Analyses

During development of the environmental analyses that follow, the planning team used the best available scientific information, which is documented in the planning record. The environmental analyses focus on the needs for changing the existing plan and the issues identified through the scoping process; they also examine potential effects to programs and resources on the Inyo National Forest.

The discussions in chapter 3 refer to the potential for consequences to occur, realizing that in many cases, they are only estimates. To estimate the consequences of alternatives at the programmatic plan level, we must assume that the kinds of resource management activities allowed under the prescriptions will occur to the extent necessary to achieve objectives and move national forest resources toward the desired conditions of each alternative. This method of analysis is useful when comparing and evaluating alternatives on a forestwide basis but it is not to be applied to specific locations on a national forest.

Several assumptions made in the analyses of alternatives, include:

- Law, policy, regulations, and applicable best management practices would be followed when planning or implementing site-specific projects and activities.
- Plan components (such as desired conditions, objectives, standards, guidelines, and suitability of lands) would be followed when planning or implementing site-specific projects and activities.
- Goals and potential management approaches would influence collaborative efforts and be considered in developing programs of work.
- Plan objectives may be stated as a range (from low to high). The actual level of accomplishment would depend on environmental conditions, budgets, and staffing.
- Implementation of a land management plan would facilitate progress toward the attainment of desired conditions for each resource. As movement toward or achievement of desired conditions is made, forest ecosystems would become healthier and more resilient and would continue to provide for species diversity, goods, and services.
- The planning period is 10 to 15 years; other timeframes may be used to compare expected future trends. Plans are expected to be revised at least every 15 years.
- Plan monitoring would occur and the land management plan will be amended, as needed.

How this Chapter is Organized

First, a general analysis of environmental consequences of drivers and stressors of climate, fire, insects, and pathogens are described since they can affect many resource areas. Then, environmental consequences are organized under each revision topic. Finally, an analysis of the benefits to people and communities and consequences to tribal relations and uses is provided at the end of this chapter to evaluate how the alternatives contribute to economic and social wellbeing.

Agents of Change: Climate, Fire, Insects, and Pathogens

Drivers and stressors are recurring events, processes, or actions that affect ecosystems. These effects are important to ecosystem condition. For example, fire creates variation in habitat, which is important for biodiversity—it keeps vegetation density and surface fuels low and patchier; it is a “driver” of ecosystem condition. Fire can be a stressor when it is more severe than usual and outside its natural range of variation, occurring either less frequently or more frequently than in the past.

The context in which fire occurs is also important. For example, because the scenery around the Mammoth Lakes area is important to this place that has great recreational value, high-severity fire can decrease the scenic character and lower the recreation value. Scenery impacts from fire can be short term if they cover small areas and are visually absorbed as vegetation recovers, or they can be long term if they cover wide visible expanses dominated by burned forest.

Other important drivers and stressors are insects and pathogens, climate change, and air pollution. Climate is a fundamental process that strongly influences other drivers and stressors in the Sierra Nevada, including fire, invasive species, insects, pathogens, water development and diversion, air pollution, and land use patterns.

In this section, three aspects of drivers and stressors are covered broadly. These include climate; trends in fire with climate; and insects and pathogens. In later sections, we discuss response of specific vegetation types, habitats (such as old forest), and ecosystem functions (such as carbon storage) to drivers and stressors. Invasive plants are one of the most important, widespread stressors on the Inyo National Forest. Invasive animals and insects are increasingly important stressors that are addressed in the “Terrestrial Ecosystems,” “Aquatic and Riparian Ecosystems” and “Wildlife, Fish and Plants” sections. Fire management is covered in revision topic 1. Air pollution impacts are covered in the “Air Resources” section.

Although climate change is an important theme in this section, it is also woven throughout many sections in the document because it influences and affects many aspects of national forests. There is a specific subsection focused on ecological vulnerabilities to climate and analysis of climate adaptation strategies proposed for each alternative at the end of the “Terrestrial Ecosystems” section.

Climate Change

Background

Climate change is anticipated to have lasting, large-scale impacts to a variety of ecological, social, and economic resources in the national forests of the southern Sierra Nevada. This section summarizes current and future trends of climate to form a foundation for other analyses in this chapter. Carbon sequestration and greenhouse gas emissions are not covered in this section but are addressed in the “Air Resources” and “Terrestrial Ecosystems” sections. The effects of climate change on specific social, cultural, and biological resources (such as cultural resources and species of special concern) are also covered in each relevant section of this chapter.

This section summarizes the more detailed analysis of climate, ecological vulnerability and adaptation found in the final bio-regional and national forest assessments (USDA Forest Service 2013a, 2013d), and the snapshots of the Living Assessment used to develop the final assessments (USDA Forest Service 2013e, f).

Recent Past and Current Trends

Mean annual temperatures in the plan area have increased in the last several decades, mostly with increased nighttime minimum temperatures (Mallek, Safford, and Sawyer 2012) consistent with larger bioregional and global patterns of increasing temperatures (Intergovernmental Panel on Climate Change 2014, Safford, North, and Meyer. 2012). Unlike much of the rest of the Sierra Nevada, overall precipitation has remained steady at higher elevations (mostly above 7,000 feet) but there have been some decreases at lower elevations (Safford, North, and Meyer. 2012). There has been a decrease in the amount of snow at low to mid-elevations and an increase in year-to-year variability (wetter wet years and drier dry years). At higher elevations, overall snowfall and spring snow water equivalent (amount of water in snowpack) have remained steady in most southern Sierra Nevada areas. Changes in temperatures and amounts and timing of precipitation have led to earlier peak stream flow rates in most Sierra Nevada streams, with higher spring flows and lower summer flows. Warming temperatures are leading to glacial recession across the southern Sierra Nevada.

The recent exceptional drought event in California (2012-2015) is unprecedented in the last 1,000 to 10,000 years for California, especially in southern and central California and including the plan area (Griffin and Anchukaitis 2014, Robeson 2015). The exceptional nature of this drought are a consequence of consecutive record low levels of precipitation perpetuated by a persistent atmospheric ridging system in the North Pacific. Recent evidence suggests that Arctic sea-ice loss has increased the potential for a North Pacific atmospheric ridge development that blocks precipitation-inducing winter storms from reaching California (Cvijanovic et al. 2017). Consequently, warming temperature trends associated with climate change may produce more extreme drought events in California (such as increased frequency or severity of drought) through the alteration of climatic systems over the Pacific Ocean (Cvijanovic et al. 2017). Although there is uncertainty inherent in these climatic systems and their effect on precipitation patterns, it is clear that climatic warming has exacerbated drought events in California through increased water stress associated with decreased soil moisture, increased runoff, and higher rates of evapotranspiration (Vose, Miniat, et al. 2016, Vose, Clark, and Luce 2016, Intergovernmental Panel on Climate Change 2014).

Projected Future Trends in Climate and Hydrology

Although climate change models vary in their projections for the latter half of the 21st century, all predict significant warming in the Sierra Nevada. Most expect precipitation to remain similar or slightly reduced compared to today (Safford, North, and Meyer 2012). Most models also agree that summers will be drier (causing higher evapotranspiration rates) on average. Although snowpack in the higher elevations (higher than 7,500 feet) of the southern Sierra Nevada has generally remained steady (or risen) over the past half-century (Meyer, Safford, and Sawyer 2012), continued warming is likely to decrease snowpack in much of the high southern Sierra Nevada.

Most models project a continuously increasing rain-to-snow ratio and earlier runoff dates for the next century, especially at higher elevations. Under most climate scenarios, models project higher winter-to-early spring runoff and lower spring-to-summer runoff, as higher temperatures hasten the onset of snowmelt. This could increase downstream flood potential due to earlier peak flow rates and the increased proportion of precipitation falling as rain. If overall precipitation increases over time, streamflow volumes during peak runoff will increase even more, leading to notably higher flood risk in downstream areas.

Fire Trends

This section summarizes trends in fire with climate and general vegetation conditions. These trends are important to understanding conditions and fire effects to terrestrial, riparian and aquatic ecosystems, and social and economic conditions.

Background

Fires have been increasingly large and severe throughout the western U.S. (Calkin et al. 2005, Westerling, Hidalgo, Cayan, and Swetnam 2006) and California (Miller, Safford, et al. 2009, Miller and Safford 2012) over the last several decades. The effects of these fires are often seen by people as overwhelmingly negative. In much of the wildlands of the western U.S. and the analysis area, fire has played a central role in shaping ecosystems. Both the beneficial and destructive aspects of fire are important to understand. The analysis examines different characteristics of fire, which can have implications for the wildlands in areas we live in and use.

In this section, the trends in burned area and fire size are addressed in response to climate change and scenarios that represent different levels of vegetation restoration. The fire responses to the scenarios are used to describe the consequences of the alternatives on large fire size and burned area. The impacts of fire to vegetation and other ecological aspects of fire are covered in more detail in the "Terrestrial Ecosystems" section. Aspects of fire related to impacts on communities, people, and infrastructure (such as water systems or powerlines) are covered in the "Fire Management," "Economic Conditions," and "Social Conditions" sections. The projected trends in fire in this section provide a common basis for assumptions on fire trends for all other analysis sections in this document.

Analysis and Methods

This section is based primarily on a quantitative analysis of fire-climate trends conducted by the University of California (UC) in Merced as part of a cooperative agreement with the Forest Service (Westerling, Milostan, and Keyser. 2015). Other scientific literature used is found in the Fire-climate supplemental report.

Climate scientists at UC Merced conducted a study to predict trends in wildfire with climate change under a broad range of different levels of vegetation restoration. The predictions are based on data from recent and past wildfires, associated vegetation condition, and climate data. The methodology was established in previously published research by Westerling and others (Preisler et al. 2008, Holmes, Jr, and Westerling 2008, Bryant and Westerling 2014, Preisler et al. 2015). This research applies a statistical approach to predicting wildfire, in contrast to mechanistic models, such as FARSITE. They are well suited for broad analysis that takes into account trends in wildfire with climate change.

Scientists made projections of climate using several different climate models, since common trends in different models would indicate a more certain trend. The results presented here are primarily for the Geophysical Fluid Dynamics Laboratory A2 climate scenario, as well as some results from the Centre National de Recherches Météorologiques (CNRM) and Community Climate System Model (CCSM) A2 climate scenario (Westerling, Milostan, and Keyser. 2015). The differences between wildfire predictions for the selected climate scenarios were small compared to the effects of the restoration treatments scenarios. The Geophysical Fluid Dynamics Laboratory climate model was emphasized because it yielded mid-century increases in wildfire activity between the CNRM and CCSM models.

Vegetation conditions were based on LANDFIRE vegetation condition class data (LANDFIRE 2012). The conditions are derived from remote sensing data on existing vegetation density and species composition and derived differences with historic conditions based on fire history research and biophysical models of vegetation type and historic fire regime groups.[21] Where there is a large departure in historic fire regime (that is, fire patterns and intensities are very different from what they used to be) and vegetation conditions are different than what they would have been under a historic fire regime, then the condition class is considered "highly departed." The range of classes include:

- vegetation condition class 1: no to low departure;
- vegetation condition class 2: moderate departure; and
- vegetation condition class 3: high departure.

An example of the conditions would be ponderosa pine or eastside Jeffrey pine that is currently dense but historically would have been maintained as open forests due to frequent, historic fire. Exploratory analysis revealed that fire patterns (large fire size, extent and burned area) varied with vegetation condition class. The vegetation condition class is a broad classification and was determined to be well suited to the programmatic plan and array of different combinations of individual vegetation desired condition components that would be the result of restoration.

Restoration treatments were modeled by changing potential treatment areas that are currently in vegetation condition class 3 or 2 to vegetation condition class 1. This is needed because previous exploratory analysis had shown that it was too difficult to discern differences in predicted fire trends between more subtle changes in vegetation condition class 3 to class 2 (Westerling 2015). The restoration treatments were not modeled in a specific spatial pattern with regards to treatment type, intensity, or frequency but as a broad landscape-level pattern to assess impacts at a programmatic level. These are referred to as "restoration scenarios" that included different types of restoration treatments (such as mechanical thinning or prescribed fire) or their combination applied over several decades. The restoration scenarios included 15 percent, 30 percent, 60 percent, and 100 percent of the area restored, with an emphasis in the Sierra Nevada montane, and Great Basin ecological zones that occur on the Inyo National Forest (see "Terrestrial Ecosystems" section). Estimated restoration treatment rates by alternative are based on estimated values presented in table 4 (next page). The priority was on areas with vegetation heavily departed from historic conditions near roads but otherwise was randomly located. More detail on the analysis can be found in the final report (Westerling, Milostan, and Keyser 2015).

A summary of fire impacts in the "Affected Environment" section was based on a combination of recent observed and future projected changes in fire in the plan area and entire bio-region. Recent fire trends were based upon data assembled for the bio-region from the National Fire and Aviation Management database and include the time periods from 1961 to 1990. This "historic" baseline from 1961 to 1990 was intended to capture recent bioregional wildfire size and severity trends for this period that: (1) occurred during a period when active fire suppression and vegetation management was in effect (and not representative of the Natural Range of Variation); (2) was characterized by lower historic temperatures that preceded most current warming climate trends that began in the 1980s; and (3) reflected more accurate and reliable regional climate, hydrology, and fire data than earlier decades (primarily 1920-1960). In addition, this time period does not take into account very recent large fires, including the Rim and King Fires, but these were

[21] http://www.landfire.gov/NationalProductDescriptions12.php

incorporated into the analysis using other information. Future projected changes focus on three periods, including early century (2010 to 2040), mid-century (2040 to 2070), and late-century (2070-2100) projections. These longer time periods are ideal in the analysis of climate change-related fire effects in land management planning efforts (Peterson et al. 2011).

Table 4. Estimated amounts of restoration activities by alternative per decade

Type of Restoration	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Acres of mechanical treatments (TERR-FW-OBJ-01)	20,000	20,000 - 25,000	At least 20,000	10,000 - 15,000	25,000 - 30,000
Acres of prescribed burning (TERR-FW-OBJ-02)	18,000	20,000 - 25,000	At least 20,000	15,000 - 35,000	20,000 - 25,000
Estimated acres of wildfires managed to meet resource objectives	11,300	58,000	64,000	34,000	119,000
Acres of nonnative invasive plants treated (INV-FW-OBJ-01)	n/a	300	300	300	300
Acres of sage-grouse habitat maintained, improved, or restored	1,500 - 7,450	1,500 - 14,900	Up to 14,900	7,450 - 22,350	7,450 - 22,350

Estimated acres for mechanical treatments and prescribed burning come from fire occurrence and accomplishment reporting data (FACTS) for the last 20 years. Estimated acres of wildfires managed to meet resource objectives were also derived from FACTS for alternative A. For alternatives B, B-modified C, and D, acres are estimated from modeled natural wildfire ignitions with positive outcomes under different Energy Release Component (ERC) percentiles. The positive outcomes are measured by the outputs from the wildfire risk assessment (See Chapter 3, Analysis and Methods). Energy Release Component is a National Fire Danger Rating System (NFDRS) index related to how hot a fire can burn. It is directly related to the potential worst-case total energy released per unit area within the flaming from at the head of a fire. The percentile values are determined from historical weather observations and provide the criteria for ranking the severity of the burning conditions on a given day: alternatives B and B-modified are less than or equal to 90th percentile; alternative C is less than or equal to the 85th percentile; and alternative D is less than or equal to the 95th percentile.

Indicators and Measures

The primary indicators measured in this analysis are burned area, large fire size (greater than 494 acres), and smoke and carbon emissions. Smoke and particulate emissions are described in the "Air Resources" section, and carbon emissions are described in the Carbon Supplemental Report. Other important indicators that are based upon inferences on large fire size, burned area, and vegetation conditions (like density and fuel levels) include fire intensity, fire type, and large areas of vegetation burned at high severity. A combination of a qualitative assessment using scientific literature and quantitative analysis using fire behavior modeling and sensitivity analysis of the statistical fire-climate model for selected areas were used to make inferences on fire intensity, fire type, and occurrence and size of large patches of high severity.

Fire intensity refers to how hot a fire burns, or the amount of heat per unit area. Fire type refers to how the fire burns in relation to the height and type of vegetation it is burning in. A surface fire, burns in the understory of forests or shrub lands or chaparral. In contrast, a crown fire burns in the tops, or crowns, of trees or shrubs. Fire severity refers to the effects of fire on vegetation or soil or other ecosystem components and is often measured at the landscape scale using remote sensing data (Miller, Safford, et al. 2009). In vegetation, fires that have higher top kill and high levels of tree or plant death are considered high severity. See the "Terrestrial Ecosystems" section for more details.

Assumptions

The analysis of fire includes several assumptions.

- The use of models predicting fire trends based on past climate-fire patterns may under-predict future trends in fires because the models are based on observations occurring under milder fire weather conditions. Because future climate is expected to exceed these conditions there is uncertainty in the fire projections.
- Some fires exhibit a fire-atmospheric interaction where the fire influences the local weather affecting the fire. There is uncertainty around the extent that this may occur but it can dramatically alter fire size, intensity, and large patches of high severity such as seen on the Rim Fire 2013 and the King Fire 2014 (Coen et al. 2015) in the central Sierra Nevada. These phenomena may be increased with continued drought and climate trends.
- High fire intensity in dry, hot conditions is expected to be reduced to moderate or low intensity or a mosaic of intensities when at least 20 to 40 percent of a landscape area is in a low or reduced fuel condition. A variety of landscape theory, fire modeling, and fire behavior case studies support this (Turner 1989, Parisien, Junor, and Kafka 2007, Parisien et al. 2010, Parisien et al. 2012, Fites-Kaufman 2014, Coen et al. 2015, Schmidt, Taylor, and Skinner 2008, Collins and Skinner 2014b), although this specific proportion is dependent on a number of landscape factors (such as strategic placement of treatments, topographic complexity, fire weather conditions) resulting in some level of uncertainty within current and future forest landscapes. Based on this information, for this analysis we assume that at least 12,000 acres or more needs to have at least 40 percent of its area restored to result in changes in fire probability, extent, and large fire size. See Fire-Climate supplemental report for more detail.

Affected Environment

Recent Past and Current Trends

Prior to European settlement, fire was widespread throughout the bio-region and California (Sugihara et al. 2006, Stephens, Martin, and Clinton 2007). The frequency, spatial pattern, and severity varied by ecosystem (van Wagtendonk and Fites-Kaufman 2006, Brooks and Minnich 2006). Most fires were low to moderate in intensity over large areas. This resulted in a mosaic of mostly surface fire, sweeping into the understory shrubs, herbs, small trees, and grasses, with small clumps or patches of fire making its way into the crowns of trees (crown fire). In montane chaparral and sagebrush, larger patches of crown fire would occur that reached the tops of the plants, killing them outright or top-killing them and stimulating new sprouts. Pinyon-juniper forests also typically experienced crown fire. See the "Terrestrial Ecosystems" section for more details on the historic and current fire regimes by major ecological zone and vegetation type. Overall, in the last century far less area has burned than did historically (Stephens, Martin, and Clinton 2007) but the severity has increased (Collins and Skinner 2014c, Mallek et al. 2013).

For thousands of years, Native Americans used fire to manage the landscape for a variety of beneficial uses (Anderson 2006). European settlement in the bio-region greatly intensified with discovery of gold in the Sierra Nevada in 1848 (Beesley 1996). At the same time, there was intensive logging to fuel steam-generated equipment and to build housing, along with extensive grazing by livestock. These early settlers affected fire directly and indirectly in numerous ways (Safford and Stevens 2017). Overall, widespread fire decreased.

Prior to the advent of modern Federal fire suppression policies (1905-1935), fire was more widespread and less intense (van Wagtendonk and Fites-Kaufman 2006, Stephens, Martin, and Clinton 2007). In the last 45 years, fires have become larger, and larger fires more frequent across the western U.S. (Calkin et al. 2005, Westerling and Bryant 2006). In the Sierra Nevada (including the analysis area), the area burned annually in federally managed forests has increased by more than 24,700 acres per decade during this period (Westerling, Milostan, and Keyser. 2015). Fire size has also changed, especially in recent years where some extremely large fires (such as McNally Fire 2002, Rim Fire 2013, and King Fire 2014) have burned, compared to the historical record. Since 1990, 9 out of the 10 largest recorded fires have occurred and 8 of those have been since 2000 alone (Steel, Safford, and Viers 2015).

Over 100 years of fire exclusion (fire suppression and lack of extensive intentional burning), along with other land uses, has changed how fire burns. Now fires burn with higher intensity, greater amounts of crown fire, and with larger areas of high severity (Miller, Safford, et al. 2009, Miller and Safford 2012, Mallek et al. 2013, Steel, Safford, and Viers 2015). Most recently, some fires have moved very rapidly, burning at high intensity in single days across large swaths. This includes the Rim Fire on the Stanislaus National Forest and King fire on the Eldorado and Tahoe National Forests. These types of fire behavior are more likely when the fire burns over large areas with multiple fire fronts and creates its own "fire weather." Extensively burning areas create their own high winds that accelerate the fire and multiple fire fronts burn toward each other (Coen 2005, Viegas et al. 2012). In the case of the King Fire, the very dry, uniformly dense overstory and understory vegetation across large areas combined to create three separate fronts or heads of the fire and an actively burning area of over 6,000 acres (Fites-Kaufman 2014). The heat from the three separate areas interacted and became one very large, several-miles-wide actively burning front and created winds of more than 40 miles per hour in front of the fire. After that, it grew to 50,000 acres burning intensely and fast. Similar vegetation conditions (such as large areas of dense understory and overstory vegetation and fuels) are common and with drought, longer fire seasons, and increasing temperatures, very large fires are likely to repeat. It is not certain exactly where and when similar fires will occur, but it is highly likely that they will occur and that the impacts will be similar to those seen in recent very large fires that burned in similar conditions.

Climate (precipitation and temperature) and fire have always been linked (Swetnam 1993). Today, changes in land use and associated changes in vegetation (that is, fewer fire-tolerant species and denser vegetation) magnify the effects of a warming climate on fire behavior.

Projected Future Trends

The projected future trends are based primarily on the statistical fire-climate models (Westerling, Milostan, and Keyser. 2015).

Burned Area

There has been a trend of increased burn area associated with low winter snowpack in the western U.S. in recent decades (Westerling, Hidalgo, Cayan, and Swetnam 2006). Predictions for the analysis area and all of the Sierra Nevada are that the burned area will double or quadruple over the next 20 to 30 years (Westerling, Milostan, and Keyser. 2015). This would not be detrimental if the fires were low intensity, but much of the area is expected to burn at high intensity due to the current vegetation density patterns and drier, longer fire season weather. Most of this increase in burn area and fire intensity is associated with larger fires.

Figure 3 shows a map of changes in the predicted burned area in the next midcentury period, from 2035 to 2064, compared to 1961 through 1990, a period prior to the advent of widespread very large high-intensity wildfires. The change is shown in colors labeled on a scale at the bottom of the figure, below the outline map of California. Light green depicts no change or a decrease in the amount of burned area. Yellow to orange represents an increase of more than 1 to 2 times the amount of burned area. Red colors depict a tripling of burned area, and the darkest maroon colors represent a quadrupling of burned area.

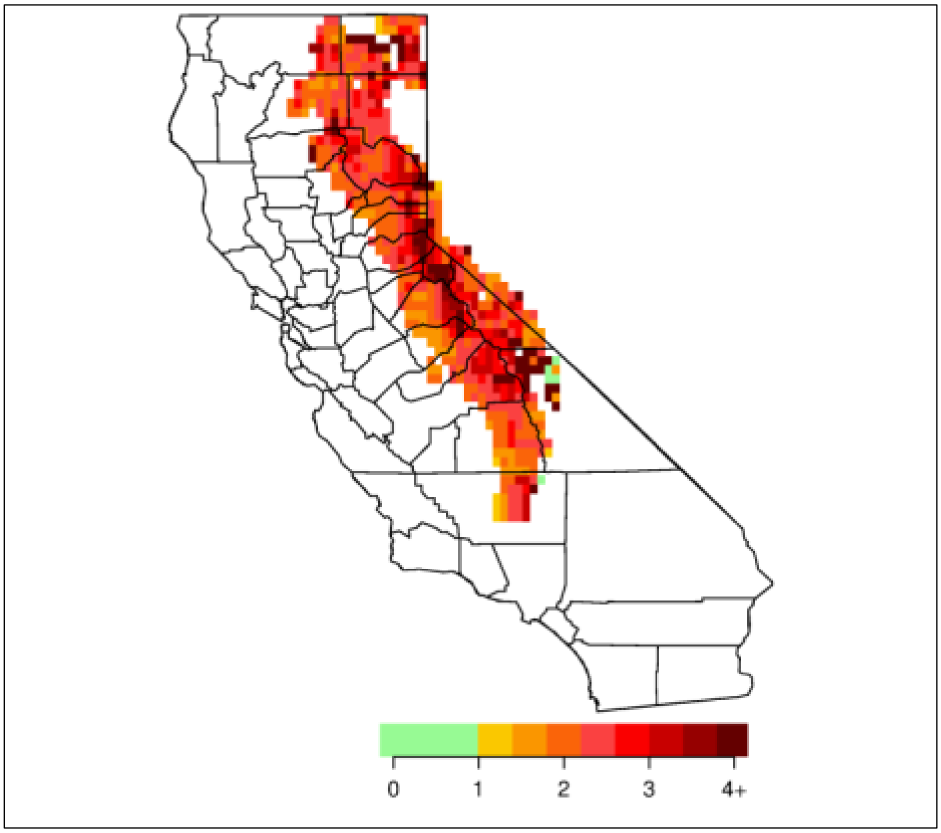

Figure 3. Map of changes in the predicted burned area in the next mid-century, 2035 to 2064, compared to 1961 through 1990

The greatest increases are expected in the upper montane and subalpine areas. The montane zone, where mixed conifer, ponderosa and Jeffrey pine forests occur show double to triple area burned. The least changes are in the lowest elevations on the west and east slopes, in the foothills on the west, and in the Great Basin sagebrush and pinyon-juniper on the east. These areas are shown in orange and still have one and a half to two times the area burned.

Fire Size and Likelihood of Very Large Fires

Average fire size is expected to increase by 13 to 20 percent by mid-century with climate change in the absence of additional treatments to restore vegetation and reduce density and surface fuels (Westerling, Milostan, and Keyser 2015). The likelihood of very large fires is increasing as well. The probability of fires becoming larger than 24,700 acres increases between 23 and 52 percent by mid-century. The average size of large fires (larger than 494 acres) is projected to increase between 15 and 25 percent in the coming decades. None of these predictions account for the growing prevalence of very large fires driven by fire-atmospheric interactions, as discussed above. Increases in fire-atmospheric interactions would contribute to an even greater increase in the size and probability of large fires.

Figure 4 shows a line graph of the expected change in large fire size with different future climate scenarios. This is based solely on changes in climate as no changes in vegetation from restoration treatments were included in this calculation. The first graph shows the predicted trends in large fire size between 2035 and 2064 for the three different climate models. The blue line is based on the Community Climate System model (CCSM). The red line is based on the Geophysical Fluid Dynamics Laboratory (GFDL) model and the green line is based on the Centre National de Recherches Météorologiques (CNRM) model. The y-axis shows the percent change in large fire size, which is predicted to increase by 13 to 20 percent over the time period.

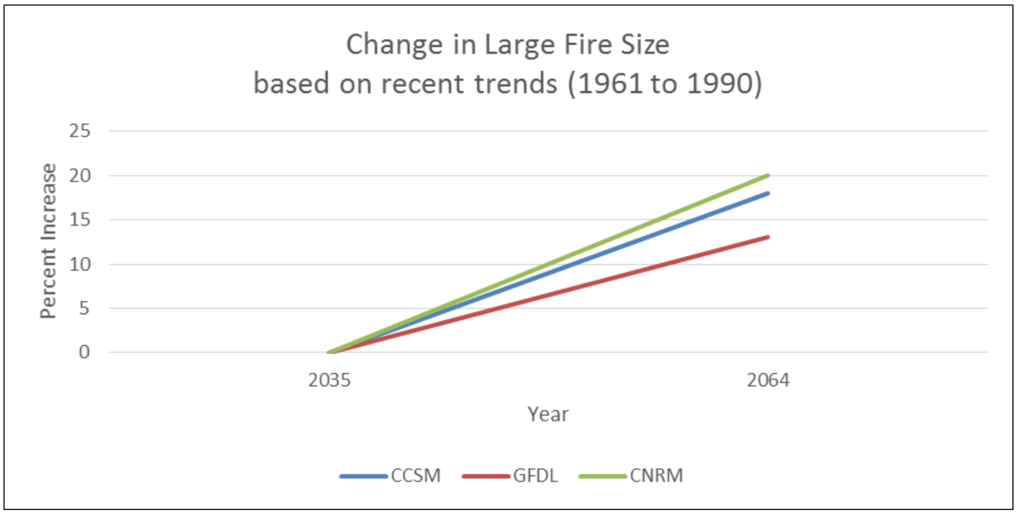

Figure 4. Predicted change in large fire size from recent (1961 to 1990) rates based on three climate models

The second line graph in figure 5, shows predicted trends when different amounts of the mid- and low-elevation landscapes are modeled as restored (from vegetation condition class 2 or 3 to class 1).[22] There is a predicted trend of increasing large fire size for all restoration scenarios except for 60 percent, which stays nearly constant with current large fire size, and 100 percent, which shows a decrease in large fire size. This is consistent with other research predicting increases in fire with climate change, such as Moritz and Stephens 2008.

The amount of predicted change in area burned in large fires varies across the plan area somewhat aligned with differences in ecological and elevational zones. The montane and upper montane landscapes have the greatest increase in likelihood of large fires, with a 30 to 55 percent increase, respectively.

Figure 6 shows predicted trends in area burned in large fires separated out by ecological zone as modeled by the Geophysical Fluid Dynamics Laboratory A2 model (or GFDL A2). It is only shown for one climate scenario because the relative differences between the ecological zones are the same across the other climate models. The increase in probability of large fires remains above

[22] Using the Geophysical Fluid Dynamics Laboratory or GFDL model

10 percent for the montane zone until the 60 percent scenario, where the trends decrease for all ecological zones except for the upper montane zone. This is because climate will have more effect on increasing fire in the upper montane zone and most treatments were prioritized in the lower elevation zones because this zone is closest to communities that has the most values at risk (homes and infrastructure). These lower elevation areas are most deviated from the desired condition and natural range of variation.

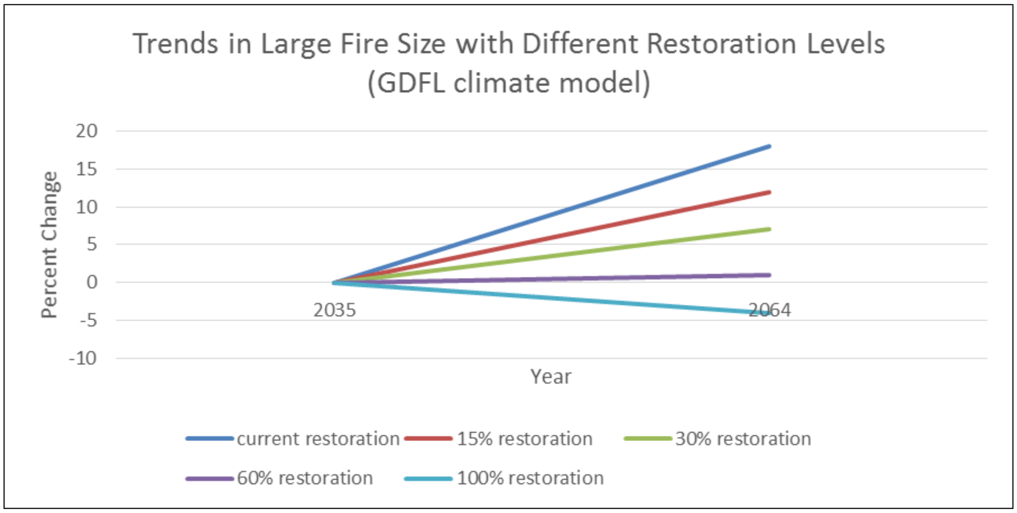

Figure 5. Line graphs showing the expected change in large fire size with different future climate and vegetation restoration scenarios

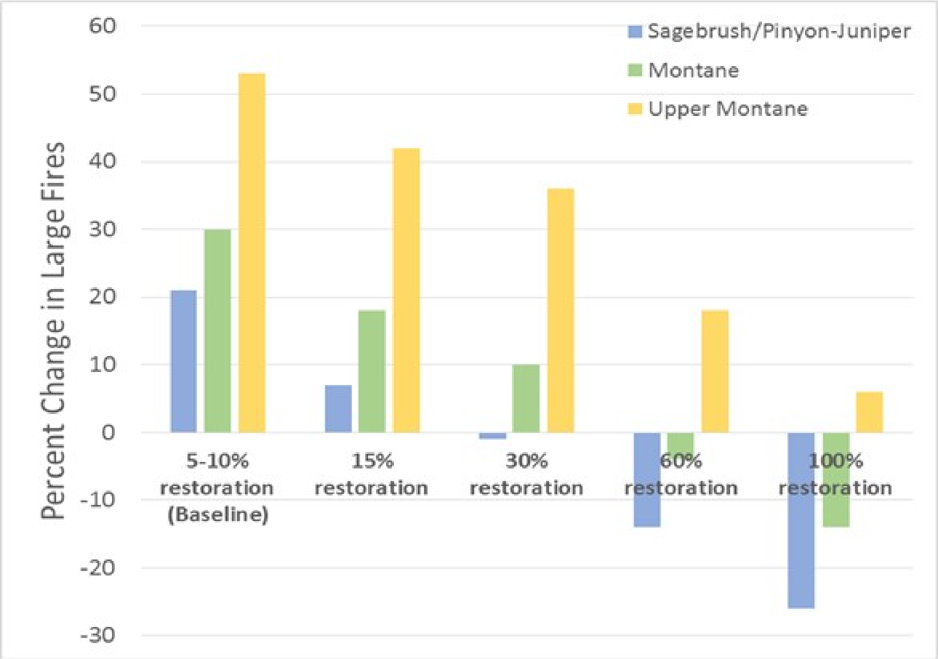

Figure 6. Bar graph showing the change in large fire size by mid-century (2035-2064) compared to “baseline” conditions (1961-1990) displayed by ecological zone and level of modeled restoration based on the GFDL model and A2 emissions scenario.

Fire Intensity, Fire Type, and Severity

Changes in fire extent and large fire size are likely to be correlated with higher intensity and higher levels of crown fire. Increased crown fire is expected because of large areas of the landscape with dense vegetation and fuels that can cause more intense and larger fires (Collins and Skinner 2014a); such fires have the potential for more fire-atmospheric interactions (Coen 2005, Werth et al. 2011) and predicted drier and warmer fire weather conditions (Westerling, Milostan, and Keyser. 2015).Warmer and drier environments cause lower fuel moisture levels and more intense fires. Once a crown fire starts, it is likely to spread in nearby areas with dense crown fuels. As described above, this can accelerate rapidly and cover very large areas in a short time if fire-atmospheric interactions occur (Werth et al. 2011), or if one part of the fire interacts with another causing a "mass fire" (Finney and McAllister 2011, Viegas et al. 2012). More information on potential fire types, including crown fire, are found in the "Terrestrial Ecosystems" section, under "Fire Resilience."

The amount and patch size of high-severity fire is most important for evaluating the consequences to ecosystems, particularly in vegetation types that historically had low- and mixed-severity fire regimes. High-severity fire is difficult to predict because it depends on the interaction of vegetation composition (size and species) and structure, and fire intensity and duration. Available research on predicting high fire severity at the landscape scale focuses on statistical analysis of fire size with fire severity (Westerling and Keyser 2016a). An analysis of fires and large areas and patches of high fire severity in the Sierra Nevada and southern Oregon, (Farris 2015, personal communication (Fites-Kaufman 2015) found that there is a correlation between very large fires (such as the Rim Fire) and both the amount of and size of large patches of high severity. This may partly be because larger fires can have larger patches of high severity whereas smaller fires physical can't. However, short but intense fire runs can burn a lot of area, particularly under extreme weather conditions, such as on the Rim and King Fires. Statistical modeling shows that high fire severity areas show similar trends with climate to the trends in burned area (Westerling, Milostan, and Keyser. 2015, Westerling and Keyser 2016b). The model predicted that fire severity was more sensitive to changes in restoration scenarios than burned area alone. In other words, with restoration, fire severity declines more sharply than in burned areas.

Modeling of trends in high fire severity with climate change and restoration scenarios by UC Merced show increasing total area burned with higher fire severity (greater than 50 percent of overstory vegetation killed) and increasing size of high fire severity patches. Figure 7 shows that in the map on the left with no fuels treatments, the area burned at high severity is expected to increase between 100 and 200 percent across most of the analysis area. The map in the middle shows the 30 percent restoration scenario, where most areas show decreases in the trend, but overall there is still a 50 to 100 percent increase in predicted area burned at high severity across the analysis area. High elevation areas show little change with the restoration scenario because most of the areas are in wilderness and wildfire managed to meet resource objectives was not modeled. The map on the right shows the 60 percent restoration scenario, where there are large landscape areas that show levels less than 20 and 40 percent growth, and some with reductions. The reductions are in areas where larger concentrations of simulated restored areas occurred. The legend on the bottom ranges from a reduction of -20 percent (green) to an increase of 300 percent (dark red) on the right.

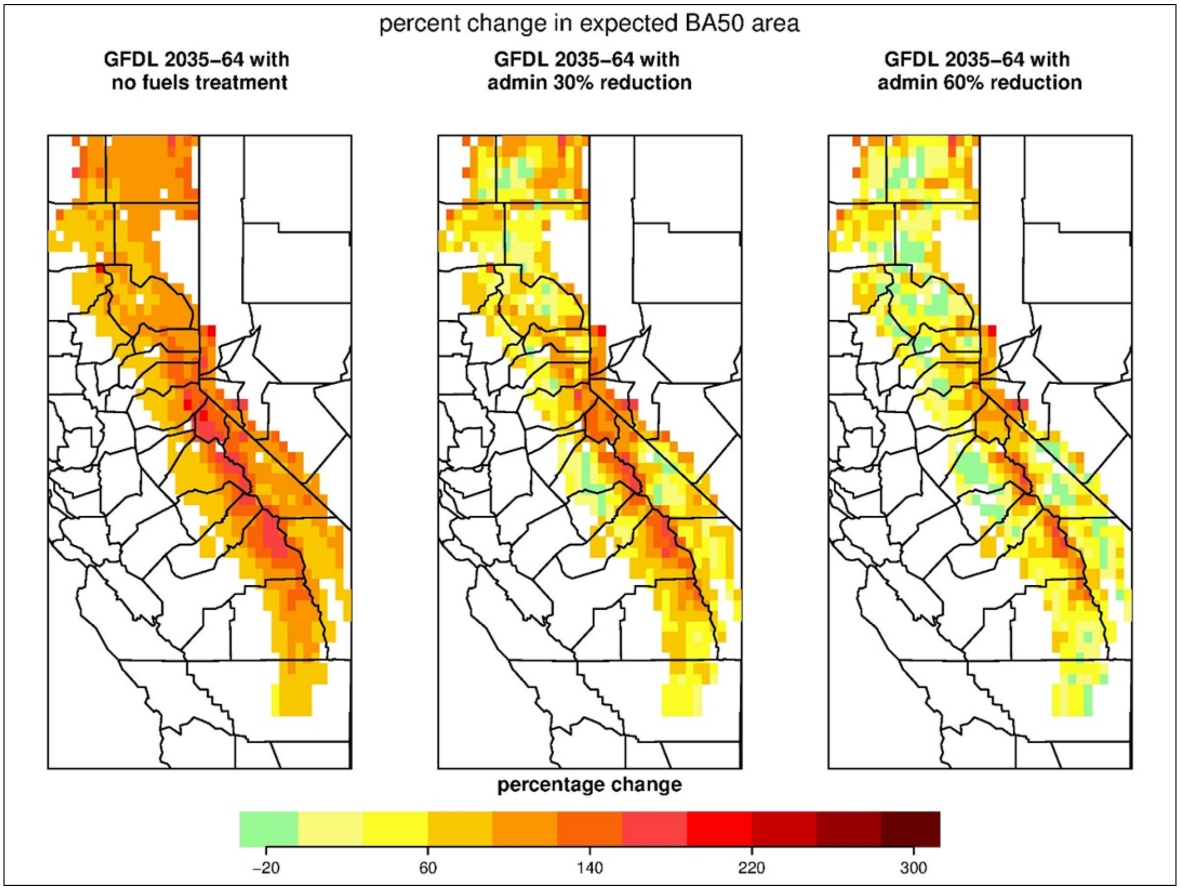

Figure 7. Percent change in area burned at high severity (defined as greater than 50 percent overstory mortality) with future trends in climate

Environmental Consequences to Fire Trends

The consequences of the alternatives were based largely on the UC Merced fire-climate modeling and how the results varied with four different restoration scenarios. Table 5 provides a summary comparing restoration levels by alternative and table 6 and table 7 provide an overall summary of the consequences of the alternatives on future fire trends.

Each alternative has proposed restoration levels of different treatment types (mechanical, prescribed fire, wildfire managed to meet resource objectives) that are described in acres that would be treated and fire ignitions that would be managed. These proposed restoration levels fall in between the restoration scenarios used in the fire-climate modeling. For example, proposed restoration objectives for alternative B (TERR-FW-OBJ-01 to 03; MA-RCA-OBJ-01; SCEN-FW-OBJ-01; SPEC-SG-OBJ-01) are mostly expressed in ranges that correspond to a restoration of 15 to 30 percent of the low and mid-elevation landscape. The proposed restoration levels for the alternatives vary by ecological zone. For example, there is little restoration planned in the subalpine/alpine zone except for wildfires managed to meet resource objectives. Table 5 below describes how the restoration levels in the scenarios were cross-walked to the restoration levels in the alternatives for this analysis.

In general, alternative A is represented by the historic “baseline” scenario, with restoration rates remaining the same at 5 to 10 percent of the landscape. Alternatives B and B-modified are represented by conditions in the 30 percent restoration scenario. Alternative C is represented by the range of conditions between the 15 and 30 percent restoration scenarios. Alternative D is represented by conditions in the 60 percent scenario. The amount of restoration depends upon the location and is described in the narrative below. For example, more remote areas may receive higher levels of managed fire, such as the Kern River drainage. In areas where there is a prevalence of tree encroachment into sage-grouse habitat and sagebrush, the level of restoration will be higher in alternatives that have higher rates of restoration (alternatives B, B-modified, and D).

Table 5. Summary comparison of proposed restoration levels by alternative

Restoration Modeling Scenario	Alternative A	Alternative B and Alternative B-modified	Alternative C	Alternative D
Current levels (historic or baseline scenario; 5-10 percent)	Yes	No	No	No
15 percent	No	No	Yes	No
30 percent	No	Yes	Yes	No
60 percent	No	No	No	Yes
100 percent	No	No	No	No

Table 6 summarizes the expected changes in fire burned area, large fire size, likelihood of large fires, and fire intensity and fire type with projected climate trends by alternative. The information is based primarily upon the analysis by UC Merced (Westerling, Milostan, and Keyser. 2015). The values are for the Geophysical Fluid Dynamics Laboratory (GFDL) model which represents the median model projections amongst the three climate models described earlier. More details on all three simulations are in (Westerling, Milostan, and Keyser. 2015). Table 7 shows the change in likelihood of large fires by alternative and by ecological and elevational zone for all areas. Both of these tables are referenced in the analysis of environmental consequences by alternative below.

Table 6. Summary of expected changes in fire burned area, large fire size, likelihood of large fires, and fire intensity and fire type with projected climate trends by alternative

Indicator	Alternative A	Alternative B and Alternative B-modified	Alternative C	Alternative D
Percent change to large fire size	23 percent increase	12 to 17 percent increase	Similar to alternative A	3 to 12 percent increase
Fire intensity and type (crown versus surface fire) in hot, dry conditions	High; decreased in areas of recent large wildfires	High, with some limited decrease (large prescribed fires, managed fire areas)	High, except decreased in limited areas (large prescribed fire and managed fire areas)	Moderate to high,
Large patches (more than 1,000 acres) of very high severity and intensity (based on increases in large fire size)	At least 23 to 30 percent increase	At least 10 to 18 percent increase	Similar to alternative A	At least 4 to 11 percent increase

Table 7. Percentage change in likelihood of large fires by alternative and ecological/elevational zone

Ecological/ Elevation Zone	Alternative A	Alternative B and Alternative B-modified	Alternative C	Alternative D
Montane	23 to 31 percent increase	3 to 18 percent increase	Similar to alternative A	10 percent increase to 11 percent decrease
Upper Montane	55 percent increase	38 to 43 percent increase	Similar but lower percent increase than B	19 to 38 percent increase
Great Basin	14 to 24 percent increase	1 to 10 percent increase	Less than A but more than B	1 increase to 6 percent decrease

Consequences Common to all Alternatives

Although there is uncertainty in all the alternatives about how much prescribed fire and wildfire managed to meet resource objectives will occur, we anticipate that management direction would support planned levels (table 4, page 83). Spring burning is when much of prescribed fire can be safely done in the dry and warmer fuel conditions that occur more frequently than in the past. In all alternatives, there are uncertainties in how much fire would occur for several other reasons. First, drier fuel conditions and longer fire seasons decrease the available window to conduct prescribed burns to safely meet burn objectives. Second, limited operating periods for deer fawning and sage-grouse would make spring burning unlikely in many areas in the montane and Jeffrey pine areas. Similarly, restrictions on burning in riparian area habitat for federally listed species such as yellow-legged frog and Yosemite toad would make spring burning more difficult in many areas. Lastly, there are uncertainties about the ability to conduct prescribed burning because of air quality constraints. Because of these uncertainties, the amount of restoration using prescribed fire may be overestimated for all alternatives.

Increases in visitors to the Inyo National Forest in general are likely to result in more human-caused ignitions. Over 90 percent of wildfires (unplanned ignitions) are ignited by people (see “Fire Management” section). Some of the fires with the largest size and highest intensity that have occurred in the analysis area and nearby were caused by human ignitions. This includes the Rim (2013) and King (2014) Fires in the central Sierra Nevada. The increase in human-caused ignitions may result in an increase of fires that become very large, very fast, and burn much of the area at very high intensity because of the combined effects of uniformly dense vegetation and high fuel loads, warming climate, drought, and invasive grasses.

Consequences Specific to Alternative A

Average annual burned acreage, large fire size, and fire intensity are expected to continue to increase under alternative A. Limited amounts of vegetation restoration, including mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives would occur in most areas. Based upon the projected trends with climate change, burned area would increase by two to four times. Much of the change would be in increasingly larger fires. These are likely to have large patches of high-intensity fire and high-severity fire effects. This is expected because of projected increases in temperature and decreased precipitation, resulting in a longer fire season. The greatest changes would be in the montane zone, except in the Kern River drainage (including the Kern Plateau). Here, there would be similar patterns of burned area but decreased fire sizes and intensities as fires burn into other recent fires from the last 15 years. There would be a continued trend of increased fire on the eastside in the pinyon-juniper, sagebrush and desert ecosystems. Fire size would continue to increase in these eastside areas, especially where extensive invasions of the nonnative cheatgrass or red brome have occurred (sagebrush, pinyon-juniper, xeric shrub and blackbrush vegetation). Nonnative annual grasses are more flammable and create more continuous fuel conditions that make fire spread more extensively (Brooks and Minnich 2006, Klinger, Brooks, and Randall 2006).

Consequences Specific to Alternative B

In alternative B, there would be an increase in the amount of vegetation restoration that would reduce the likelihood of large fires, burned area, and large patches of high fire severity (TERR-FW-OBJ-01 to 03; MA-RCA-OBJ-01; SCEN-FW-OBJ-01; SPEC-SG-OBJ-01). There would be a continued trend of increasing burned area, large fire size, and fire severity with climate trends (figure 3, figure 6, figure 7); however, the rate of increase is lower (12 to 17 percent increase) than current rates of increase (23 percent) represented by alternative A (figure 6, Table 6). The proposed restoration levels would vary with location in the landscape. Treatments would be prioritized in the montane, (WRZ potential management approach) sagebrush (SPEC-SG-OBJ-01), and pinyon-juniper areas, including around communities (MA-CWPZ-GOAL-01 to 02), and other high value areas (TERR-FW-OBJ-01). In addition to restoration objectives, the following potential management approaches in this alternative emphasize priorities in these areas:

> Areas that historically supported more frequent fire, like Jeffrey pine-dominated forests, and areas with high existing levels of understory fuels are prioritized for treatment.
>
> Prioritize fuel treatments in areas that pose the greatest threat to communities and highly valued resources.

In some areas, such as Jeffrey pine forests on the Inyo National Forest there would be increases in restoration over current levels (table 4, page 83). In these areas, where about 30 percent of the area is restored to desired conditions, there would be decreases in fire intensity (Coen et al. 2015), high fire severity (Wimberly et al. 2009), and size of large patches of high severity. There may be some effect of decreasing large fire size overall when fires burn into treated areas, but this is more likely when larger treatments areas are concentrated within a landscape (that is, greater than 12,000 acres; see analysis assumptions above). Goals (FIRE-FW-GOAL-01 and 03) and potential management approaches emphasize treating larger landscape areas, using mechanical treatments and larger prescribed fires:

> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience and fire resilience, and to protect the carbon carrying capacity of the forest.
>
> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.
>
> During ecological restoration treatments, reduce fuels along ridges, roads, or other natural or man-made features to aid in the use of large prescribed fires and in managing wildfire, including wildfires managed to meet resource objectives.

The ability to conduct treatments within these prioritized areas affects the likelihood that sufficient treatments would occur to result in changes in large, high-intensity size and high fire severity areas from future fires. There is a moderate level of uncertainty that the levels of projected prescribed fire treatments would occur due to smoke management and air quality concerns, agency capacity and budgets, and potential impacts to natural and cultural resources (for example, limited operating periods established to protect wildlife described above in consequences for all alternatives). Without prescribed fire in mechanical treatment areas, it is less likely that all of the desired conditions for vegetation would be attained, particularly for understory plant diversity, and surface fuels reduction. This may mean that mechanical treatment restoration activities are less effective in changing fire behavior and restoring ecological pattern and process when these treatments are not combined with prescribed fire (Wimberly et al. 2009).

Changes in fire management toward a risk-based approach (strategic fire management zones, see "Fire Management" section) would result in more wildfire that is managed to meet resource objectives, especially in the wildfire maintenance zone (MA-WMZ-GOAL-01; MA-WMZ-STD-01 to 02) and in some portions of the wildfire restoration zone (MA-WRZ-DC-02 to 03; MA-WRZ-GOAL-01); some limited opportunities to manage wildfires to meet resource objectives may also be available in the general protection zone under specific conditions. This would result in decreased fuels, increased vegetation resilience, and has been shown to reduce future fire size and severity (Collins et al. 2009, Ewell, Reiner, and Williams 2012, Vaillant 2009), but most of these fires would occur at higher elevations in more remote locations. Implementing the plan management strategy of emphasizing ecological restoration along ridges and some roads would improve the ability to reduce the intensity and spread rate of wildfires, manage fires to meet resource objectives, and conduct prescribed fires (MA-CWPZ-GDL-02; MA-GWPZ-GDL-01; MA-WRZ-STD-01; MA-WMZ-STD-02). It would contribute to fire suppression success and allow more wildfires to be managed to meet resource objectives but to an unknown degree because there are other factors influencing fire management decisions including weather, fuel conditions (how dry fuels are) and proximity to communities or values at risk (see "Fire Management" section).

In alternative B, there would continue to be large, high-intensity fires, with large patches of high intensity and severity, driven by fire-atmospheric interactions where fires generate their own weather and accelerate winds and fire intensity and spread (Coen et al. 2015). Similar to alternative A, large and intense wildfires would continue to expand in sagebrush and pinyon-juniper woodlands, especially where cheatgrass invasion has occurred. However, greater effectiveness of vegetation restoration is projected in the sagebrush and pinyon-juniper areas under alternative B, where model projections show that treating one-third of landscape areas has benefits in reducing the likelihood of large fires (figure 7). Nevertheless, there is uncertainty in the effects of restoration treatments because continued invasion and establishment of nonnative, annual grasses can cause increases in fire spread and fire size in other untreated areas.

Consequences Specific to Alternative B-modified

The consequences of alternative B-modified would be similar to alternative B, but there would be a marginally higher restoration treatment rate under alternative B-modified. This is due to the higher rates of treatment from wildfires managed to meet resource objectives under alternative B-modified, which would result in an additional 6,000 acres per decade treated with managed wildfire compared to alternative B. This will result in about a 2 percent increase in restoration treatment rates for relevant vegetation types on the Inyo National Forest (such as montane forest and sagebrush). Although 133,490 acres (or 7 percent of the total acres on the Inyo National Forest) under alternative B would be reclassified from the Maintenance or Restoration Fire Management Zone to the General Wildfire Protection Zone under Alternative B-modified, nearly all of these acres are located in the sagebrush vegetation type, where the primary restoration approaches would rely on methods other than wildfires managed to achieve resource objectives (prescribed burning and mechanical thinning of encroaching conifers).

Additional differences between alternatives B and alternative B-modified have negligible or no effects on treatment rates in the plan area. These include the removal of riparian conservation areas from the suitable landbase for timber production (see appendix A: Timber Suitability and Management), development of an aquatic conservation strategy (and designation of associated conservation watersheds), and changes to the Species of Conservation Concern list.

Alternative B-modified would result in increased vegetation restoration that would reduce the likelihood of large wildfires that contain large patches of high-severity fire. With projected future climate trends, there would be a continued trend of increasing burned area, large fire size, and fire severity under alternative B-modified due to the effect of increasing temperatures on wildfire activity. Similar to alternative B, prioritized treatments in montane forest, sagebrush, or pinyon-juniper woodland, including around communities and other high value areas, would result in the greatest reduction in the likelihood of large and severe wildfires under alternative B-modified.

In alternative B-modified, there would continue to be large and intense fires driven by fire-atmospheric interactions. Similar to alternative B, cheatgrass invasion would continue in sagebrush and pinyon-juniper woodlands following large wildfires, especially in areas of existing cheatgrass expansion. Continued cheatgrass invasion could cause increases in fire spread and size particularly in recently burned sites.

Consequences Specific to Alternative C

The consequences of alternative C would be similar to alternative A but there are uncertainties associated with the potential restoration amount and intensity in alternative C (table 4, page 83). The proposed area treated with prescribed fire and wildfire managed to meet resource objectives would increase and potentially double on the Inyo National Forest under alternative C compared to alternative A. Mechanical treatment on the Inyo National Forest would decrease by about 75 to 100 percent. In addition to changes in the relative amounts of different treatment types, the intensity of treatments would be similar to alternative A and less than alternative B. Vegetation restoration is likely to be low treatment intensity because of an emphasis on retaining more vegetation cover and key habitat structures for greater sage-grouse, Pacific fisher, Sierra marten, California spotted owl and other wildlife species.

There are fewer strategic fire management zones in alternative C, with more area emphasizing restoration of wildfire for resource objectives. However, the fire risks remain the same as in the other alternatives so it is expected that fire management decisions would be the same as alternative A, except in the wildfire maintenance zone. With this alternative, less area would have mechanical restoration and those actions would be less intense in reducing fuels and reducing fire risk. Alternative C strives to use more prescribed burning to reduce fuels and achieve desired conditions, but the amount of burning may be limited in some areas by the greater difficulty of burning areas with higher fuel loading and the same limited operating period constraints listed above in consequences common to all alternatives. There would likely be less ecological restoration along ridges and some roads using mechanical treatment alone or in combination with prescribed fire, which would make it more difficult to manage wildfire to meet resource objectives. Fewer acres would be restored in Jeffrey pine, pinyon-juniper, and sagebrush using mechanical treatment, prescribed fire, or wildfire managed to meet resource objectives. There would continue to be increases in the size and area of large, high-intensity fires, particularly where cheatgrass invasion has occurred.

Consequences Specific to Alternative D

Alternative D is proposed to have the greatest level of restoration treatments of all kinds (table 4, page 83). Proposed plan direction guiding restoration treatments and fire management would be mostly similar to alternative B. Treatment areas in many areas of the Inyo National Forest would double. A greater proportional area is also restored (up to 30 percent). These increases in restoration are to levels where the fire-climate models predict there would be a leveling off or decrease in the current trend of greater likelihood of very large fires (table 6, table 7; Westerling, Milostan, and Keyser. 2015). Given the combination of more restored areas that would be less susceptible to high-intensity fire, there is expected to be a decrease in the amount of crown fire and large patches of high-severity fire trending toward the natural range of variation. There would be substantially more ecological restoration of ridges and roads that that can provide more opportunities to conduct large prescribed fires in steep areas (like in canyons) and to manage wildfire to meet resource objectives. This would increase the likelihood that more area is burned under low- to moderate-intensity conditions that decrease fuels, provide ecological benefits and further decrease the likelihood of large, high-intensity fires beyond the natural range of variation. However, in sagebrush and pinyon-juniper woodlands, large, high-intensity wildfires would be expected to occur, especially in areas of cheatgrass invasion. There is uncertainty about how much smoke regulations and air quality management would affect this potentially greater amount of prescribed fire and wildfires managed to meet resource objectives.

Cumulative Effects

There are cumulative effects spatially, from the management of adjacent landowners, and into the future with foreseeable trends in climate, human populations, and fire. Climate trends are influenced by many factors outside of the direct influence of projects and indirect influence of the plan revision alternatives. Trends in large, high-intensity fires are influenced by restoration treatments in adjacent areas and in the numbers and types of ignitions and fire management policy. Large adjacent land managers include the National Park Service, managing Sequoia, Kings Canyon and Yosemite National Parks, and the Bureau of Land Management. There are also large areas of private land next to and within the national forest in the analysis area. The Park Service emphasizes fire restoration and has cooperated with the Forest Service numerous times on management of wildfires to meet resource objectives in the southern Sierra Nevada (Meyer 2015a). There are also smaller private in-holdings and adjacent private lands where restoration treatments may occur. The draft forest plans emphasize an all-lands-management and shared-stewardship approach and this would occur with alternatives B, C and D (FIRE-FW-DC-02 to 03; LAND-FW-DC-02; TRIB-FW-DC-02; LOC-FW-DC-01 and 02; FIRE-FW-GOAL-02 to 04; LOC-FW-GOAL-01; VIPS-FW-GOAL-01). This includes the following potential management approaches:

> Work with adjacent land management agencies to identify methods to reduce costs and increase effectiveness in restoring fire to the landscape.
>
> Prior to and during the fire season assess conditional thresholds under which desired conditions can be met for the strategic fire management zones (see management areas section in this chapter). Work with tribes and adjacent landowners to identify areas and resources of value considered in the assessments.
>
> Develop a partnership and volunteer strategy to define the types of projects suitable for partnership and volunteer opportunities, potential partners and volunteers, and the mechanisms for developing partnerships and volunteer agreements.

The cumulative effect has been that on adjacent National Park Service and Sequoia National Forest lands there is a high level of restoration that has been accomplished in the last 15 years, greatly reducing the probability of large, high-intensity fires in this area. The Bureau of Land Management manages fires similarly to the Forest Service although with more of an emphasis on fire suppression. Consequently, there has been little wildfire managed to meet resource objectives on National Forest System lands near Bureau of Land Management lands.

Increases in nonnative annual grasses within sagebrush and pinyon juniper vegetation of adjacent land ownerships can increase the frequency of large wildfire occurrence onto national forest lands. Areas adjacent to the Inyo National Forest managed by the Bureau of Land Management and the Los Angeles Department of Water and Power are both at risk of nonnative plant invasions, spread, and associated increased fire size. The cumulative effect would be more fires burning across jurisdictional boundaries that could increase the total number of large wildfires burning on the Inyo National Forest.

Wildfire ignitions may increase in the Sierra Nevada with increased population growth (including increased human development in the wildland-urban intermix) and climate change. However, future projections in human-caused ignitions and lightning strike density are highly uncertain (especially the latter). This would have a cumulative effect of increasing the likelihood of large, high-intensity fires but to an unknown degree. Although some regions of the western United States may experience projected declines in wildfire extent and severity with climate change (due to reduced plant productivity in the later 21st century), total burned area and fire severity in the Sierra Nevada are likely to increase or remain moderately high through the coming decades (Lenihan et al. 2008, Westerling et al. 2011, Parks et al. 2016).

Analytical Conclusions

Under all alternatives, trends in climate remain the same but the landscape vegetation density and fuel levels would differ because levels and intensity of restoration differ by alternative. As a result of both these factors, the likelihood of large, high-intensity fires differs among alternatives, even with climate trends that result in more severe fire weather (table 6). With alternatives B, B modified, and D, there is a high likelihood that the trend in large, high-intensity fires may not get any worse (table 6). In montane forests, there is a reduction in the likelihood of large high-intensity fires with alternatives B and B modified, but the trend is still increasing with climate change.

There is more uncertainty in alternatives B and B modified that larger landscape prescribed burning would occur compared to alternative D due to less understory fuels reduction in fewer mechanically treated areas. This increases the uncertainty that there would be enough treatment to decrease the trend in large fire size or area burned in large fires. In alternatives C and A there is a high likelihood that the current trend of increasing occurrence of large, high-intensity fires will continue or worsen. In all of the alternatives, any large area (greater than 12,000 acres) that has extensive restoration (greater than 40 percent) is likely to have a substantially lower probability of large, high-intensity fires and high-severity fire effects (Turner 1989, Wimberly et al. 2009, Parisien, Junor, and Kafka 2007, Parisien et al. 2010, Parisien et al. 2012, Fites-Kaufman 2014, Coen et al. 2015, Westerling, Milostan, and Keyser. 2015). This situation currently occurs in the Kern Plateau and is likely to continue and expand across more of that area.

Insects and Pathogens

Background

Native insects and pathogens are an integral part of forest dynamics and process of change in the southeastern Sierra Nevada. Naturally occurring pathogens, often called "diseases," include fungi or plants that can play important roles creating cavities or snags used by wildlife. This section focuses on the insects and pathogens that affect trees.

Environmental factors such as drought, wildfires, or vegetation conditions strongly influence behavior of native insects and pathogens. While native insects and pathogens affect their host plants to varying degrees, some are considered key species due to their ability to cause widespread or severe tree mortality. Species that can kill the most trees, including more than seven species of bark beetles, are listed in table 8.

Table 8. Key forest insect and pathogen species of the southeastern Sierra Nevada: "H" indicates relatively high ability to kill host trees; "L" indicates secondary or lower ability to kill host trees; and "O" indicates occasional hosts.

Key Pest Species	Type	Host Trees
Western pine beetle	Bark beetle	High: ponderosa pine
Mountain pine beetle	Bark beetle	High: five-needled pines, lodgepole pine Low ponderosa pine
Jeffrey pine beetle	Bark beetle	High: Jeffrey pine
Fir engraver	Bark beetle	High: white fir, red fir
Pinyon ips	Bark beetle	High: single-leaf pinyon pine
Pine engravers *(Ips* spp.*)*	Bark beetle	High: ponderosa pine, Jeffrey pine, 5-needled pines*, single-leaf pinyon pine, lodgepole pine
California flatheaded borer	Wood borer	High: Jeffrey pine
Red turpentine beetle	Bark beetle	Low: ponderosa Pine, Jeffrey pine, 5-needled pines*, single-leaf pinyon pine, lodgepole pine
Douglas-fir Tussock moth	Defoliator	High: white fir
Pandora moth	Defoliator	High: Jeffrey Pine
Dwarf mistletoes	Parasitic plant	High: ponderosa pine, Jeffrey pine, sugar pine, lodgepole pine, white fir, red fir Low: 5-needled pines*, single-leaf pinyon pine
Heterobasidion root disease	Root fungus	High: white fir, red fir Low: ponderosa pine, Jeffrey pine, 5-needled pines*
Black stain root disease	Canker fungus	High: single-leaf pinyon pine
Armillaria root disease	Root fungus	Low: 5-needled pines, lodgepole pine, white fir, red fir, incense cedar, giant sequoia, California black oak Occasional: ponderosa pine, Jeffrey pine
White pine blister rust	Canker fungus	High: 5-needled pines*

Five-needled pines include sugar pine, whitebark pine, and bristlecone pine

White pine blister rust is a nonnative invasive pathogen that is very deadly to white pines. Bark beetles are the leading cause of damage and mortality of trees, and the recent outbreaks across western North America are the largest and most severe in recorded history (Bentz 2005). A 2009 update report from Western Forestry Leadership Coalition stated that between 2002 and 2003, acres affected by bark beetles increased from 4 million to 10 million acres across the west (Coalition 2009). Future projections estimate that bark beetle and other forest insect activity will increase due to climate changes such as elevated temperatures, frequent drought, and current high risk conditions (ex: dense vegetation) of western forests (Bentz et al. 2010).

In 2011, the Forest Service produced a western bark beetle strategy to develop future prevention management strategies to mitigate the widespread epidemic of bark-beetle-killed trees occurring all through the western states (USDA Forest Service 2011e). The strategy is based on three primary goals: human safety, forest recovery, and long-term forest resiliency. High levels of bark-beetle-killed trees create serious safety concerns, due to the risk of hazardous trees falling on the public and damaging property. The rapid loss of trees affects ecosystem integrity, dramatically changing the structure and composition of vegetation and distribution of trees. This in turn decreases stability of forests, and alters ecological function. After significant bark beetle infestations, forest stands may or may not return back to original conditions; dead trees can increase wildfire potential; and loss of keystone tree species affect associated wildlife or vegetation. Thinning treatments to reduce forest density toward the natural range of variation can make stands more resilient and reduce the likelihood and amount of trees killed by bark beetles. Salvage logging after infestations can recover the economic value of the dead trees, create openings for reforestation, and improve overall human safety and recreational opportunities.

Analysis and Methods

Numerous research studies have examined how forest conditions affect the likelihood and level of insect and pathogen impacts to trees. This includes measures of stand density, suitable diameter classes, or forest composition as potential risk factors for pest attack, especially bark beetles. Higher numbers of dying trees are often correlated with areas of densely growing trees for most bark beetles and their respective hosts. Drought conditions are included as a factor influencing the likelihood that attacks will occur.

Despite measures that gauge insect and pathogen activity, discussions of environmental consequences of alternatives are qualitative assessments. Insect and pathogen activity viewed at forest-level scales is addressed qualitatively because monitoring information is primarily based on general trends across the larger forested landscape. The levels of insects and pathogens were compared with information on reference conditions, or what is within the natural range of variation (Safford and Stevens 2017; see “Terrestrial Ecosystems” section). These are also referred to as “background levels.” Little information pertains to presettlement (natural range of variation) estimates of insect and pathogen activity and associated tree mortality in the Sierra Nevada, including the Inyo National Forest. However, inferences related to insect- and pathogen-related tree mortality can be drawn from the comparison of recent past, current (contemporary forests on the Inyo National Forest and modern reference sites with intact disturbance regimes), and projected future conditions.

Indicators and Measures

Effects and impact severity due to forest insects and pathogens are often measured by several factors: affected acres, trees killed per acre, or percentage of trees affected. Annual aerial surveys are conducted by the Forest Health Monitoring Program under the Forest Service’s State and Private Forestry Program, which visibly detects and records areas of dying trees caused by forest insects and diseases on the landscape. The Forest Service’s Forest Health Protection Program has multiple tools in which to evaluate measures. Numbers of trees dying that are higher than background levels are often indicators of increasing pest activity or areas of growing infection by diseases. Unusual patterns of dead trees with particular host plants can also indicate pest presence. Compilation of acres affected or trees killed can provide indications of trends emerging on the landscape.

Forest Health Technology Enterprise has developed computer modeling tools that assess loss risks from forest pests based on current stand conditions (USDA Forest Service 2012a). Gradations of risk are assessed up to greater than 25 percent basal area lost; considered the highest risk over a span of 15 years. Maps of specific locations or forests can be developed, which assess levels of risk.

Assumptions

Most forest insects and pathogens are native. Current conditions of dense forested stands or predominance of shade-tolerant trees have significantly changed forests from the historic range of natural variation (Safford 2013, Slaton and Stone 2015a, Slaton 2013b). In general, bark beetles target dense stands because trees in these conditions are often stressed or weakened due to high competition for water and resources. Drought further stresses trees, triggering increased bark beetle attack. These trees are less able to produce defensive resins used to fend off bark beetles drilling into the cambium. For ponderosa pines in California, studies determined that stands with highest densities are most often first infested (Oliver 1995, Hayes, Fettig, and Merrill 2009). If droughts become more frequent, of greater intensity, or last longer in the future, higher levels and more wide-spread bark beetle-caused mortality should be expected.

Trees killed by insects and pathogens do provide important contributions to ecosystem function when they are at levels within the natural range of variation. Bark beetles and wood boring insects provide forage for wildlife such as woodpeckers. Dead trees, standing or down, create essential habitat and organic biomass for forests. Trees killed by native insects and pathogens can result in small-scale disturbances that keep forests dynamic and regularly changing, by creating small openings and increasing heterogeneity (Fettig 2012). Native insects and pathogens are also used by Native American Tribes. For example, on the Inyo, Tribes use Pandora moth larvae (called piagi) as a traditional food source. Mushrooms, the fruiting bodies of pathogens, are used as food and medicine by Native American Tribes as well.

Restoration treatments in forests to reduce tree density can restore forests to conditions similar to the natural range of variation's associated background levels of insect and pathogen-related tree mortality (Fettig 2012). Reduced tree density, more varied structure, and diverse tree composition will significantly reduce susceptibility of trees to attack and infection and improve individual resistance mechanisms (Smith 2007, Fettig et al. 2007). One measure of forest density that is used to evaluate susceptibility to bark beetles, is stand density index. This measure is weighted by tree size and tree density, so stands containing a higher density of trees and that are dominated by small trees have higher index levels. This is partly because more small trees can "crowd" into the same space as fewer large trees. Light thinning, and especially thinning limited to small trees, may not reduce stand density index sufficiently to change conditions that attract bark beetles (Oliver 1995). Prescribed fires alone may not reduce stand density index sufficiently if they are low intensity and can create situations that make trees more vulnerable to attack in the short term (Fettig et al. 2008). However, large wildfires managed to meet resource objectives can result in significant reductions in forest density and reduced susceptibility to insect attack (see "Affected Environment" section below). This is evident in the current outbreak where lower levels of dying trees are occurring on the Kern Plateau where extensive managed fires have occurred in the last 15 years (Meyer 2015a). Heterogeneity across the landscape can also disrupt the expansion of insect activity. Variation of tree size, age, or species composition may limit the amount of suitable host material and, thus, reduce the number of dying trees (Fettig 2012).

The effects of treatment on insect and pathogen levels and susceptibility vary some by treatment type and combinations. Combinations of mechanical and prescribed fires have been found to be less attractive to bark beetles than prescribed fire treatments alone, as well as improving overall tree health and growth (Feeney et al. 1998, Wallin et al. 2008). Fire may result in heightened bark beetle activity due to the nature of injury that fire causes (Davis et al. 2015). Crown and bole scorch severity are two of the primary factors used to gauge tree survival but also susceptibility to bark beetle attack (Hood et al. 2007, Smith and Cluck 2011). Studies on bark beetle impacts followed by prescribed fires have determined that the likelihood of bark beetle infestation significantly increases with burning alone (Fettig et al. 2008, Fettig and McKelvey 2010)). Therefore, it is important to recognize potential subsequent effects following a burn when drought events or underlying resource stress (such as high tree densities) are also present.

Affected Environment

Current forest structural conditions of increased tree densities are considered outside of the natural range of variation and prone to insect and pathogen outbreaks beyond background levels. Recent and ongoing, widespread, high levels of insect-related tree mortality reflect these conditions, magnified by drought (Asner et al. 2015) and temperature increases (Van Mantgem et al. 2009). Past management activities have changed forest structure, leading to changes in tree species diversity, age classes, and density. Although current levels of tree mortality (and associated bark beetle activity) on the Inyo National Forest are within the upper portion of the natural range of variation (Allen, Breshears, and McDowell 2015, McDowell et al. 2016), these levels are expected to exceed the natural range of variation in the near future as a consequence of the effects related to climate change (Allen, Breshears, and McDowell 2015, McDowell et al. 2016). During the recent extreme drought (2012-2015), levels of drought stress and associated tree mortality were orders of magnitude lower on the Inyo National Forest than on the west slope of the southern Sierra Nevada in the Sierra and Sequoia National Forests (Preisler et al. 2017).

Bark Beetles

Currently, there are extensive areas of trees with high or very high mortality related to drought, increased temperatures, and bark beetle activity in the pinyon forests of the White Mountain and Whitney Ranger Districts, and in the whitebark and lodgepole pine forests on all ranger districts (figure 8 and figure 9; USDA Forest Service 2015a). These levels are greater than what has occurred in the last 50 years but there have been other outbreaks and associated increased tree mortality. For example, levels of tree mortality in white and red fir have been increasing on the Mammoth Ranger District, especially in the area between the Sherwin Mountains near Mammoth Lakes and June Lake. Over the past four decades, California has experienced significant drought events that have triggered high levels of bark beetle-associated tree mortality. From 1992 to 1994, more than 1,430,000 acres of trees (primarily true firs) were killed statewide; in 2002 to 2005, over 6,688,400 acres of pines were killed, primarily in southern California forests.

On the Inyo National Forest, the greatest concern is loss of pinyon and keystone high elevation species, such as whitebark pine. Since 2006, more than 61,000 acres of whitebark pine, an estimated 425,000 trees, have been affected by mountain pine beetle in California. An average of over 80 percent of the basal area and 75 percent of canopy cover has been lost in some areas of the Inyo National Forest impacted by mountain pine beetle (figure 8; Meyer et al. 2014b, Meyer et al. 2016). Pinyon *Ips*, often in association with black stain root disease, is causing widespread mortality where pinyon occurs on Inyo National Forest, most recently in the Inyo and White Mountains, John Muir, and Golden Trout Wilderness.

Figure 8. Photo of dead and dying whitebark and lodgepole pines on June Mountain Ski Area, 2009

Defoliators

Other insects that cause noticeable and significant damage have been defoliators, insects that eat the needles or leaves of trees and can kill the trees when attacks are severe. The native Douglas-fir tussock moth cycles in population boom and bust every 7 to 10 years. White firs are its primary host, but other neighboring species can be affected if populations are high. From 1996 to 1999, 44,000 acres in Sequoia-Kings National Park and Sequoia National Forest were defoliated; about 5,800 acres were severe (USDA Forest Service 2015a). Pandora moth is infrequent, but outbreaks can cause severe localized damage. Both insects become public safety hazards: Douglas-fir tussock moth larvae have urticating hairs that cause severe respiratory problems in sensitive individuals; Pandora moth larvae can become so numerous on roads or other public settings to create treacherous conditions. As mentioned previously, Pandora moth is also a valued resource collected by tribal members.

Dwarf Mistletoes and Root Diseases

Dwarf mistletoes and root diseases can have profound long-term effects on forest structure and composition. Forest pathogens work slower than insects in killing individual tree hosts by extracting water and photosynthates (sugars and other chemical products of photosynthesis), crippling and deteriorating tree metabolism and vigor. Infected hosts are thereby more susceptible to structural defect related failure or attack by secondary pests that eventually kill the tree. Dwarf mistletoes are highly evolved parasitic plants that persist on individual trees for decades causing dieback or severely reducing growth and development. *Heterobasidion* spp. is the most common root disease found in the southern Sierra Nevada forests; true firs are highly susceptible to *Heterobasidion* infection. Pinyon pine trees infected with black stain root disease are susceptible to mortality from *Ips confusus* bark beetle.

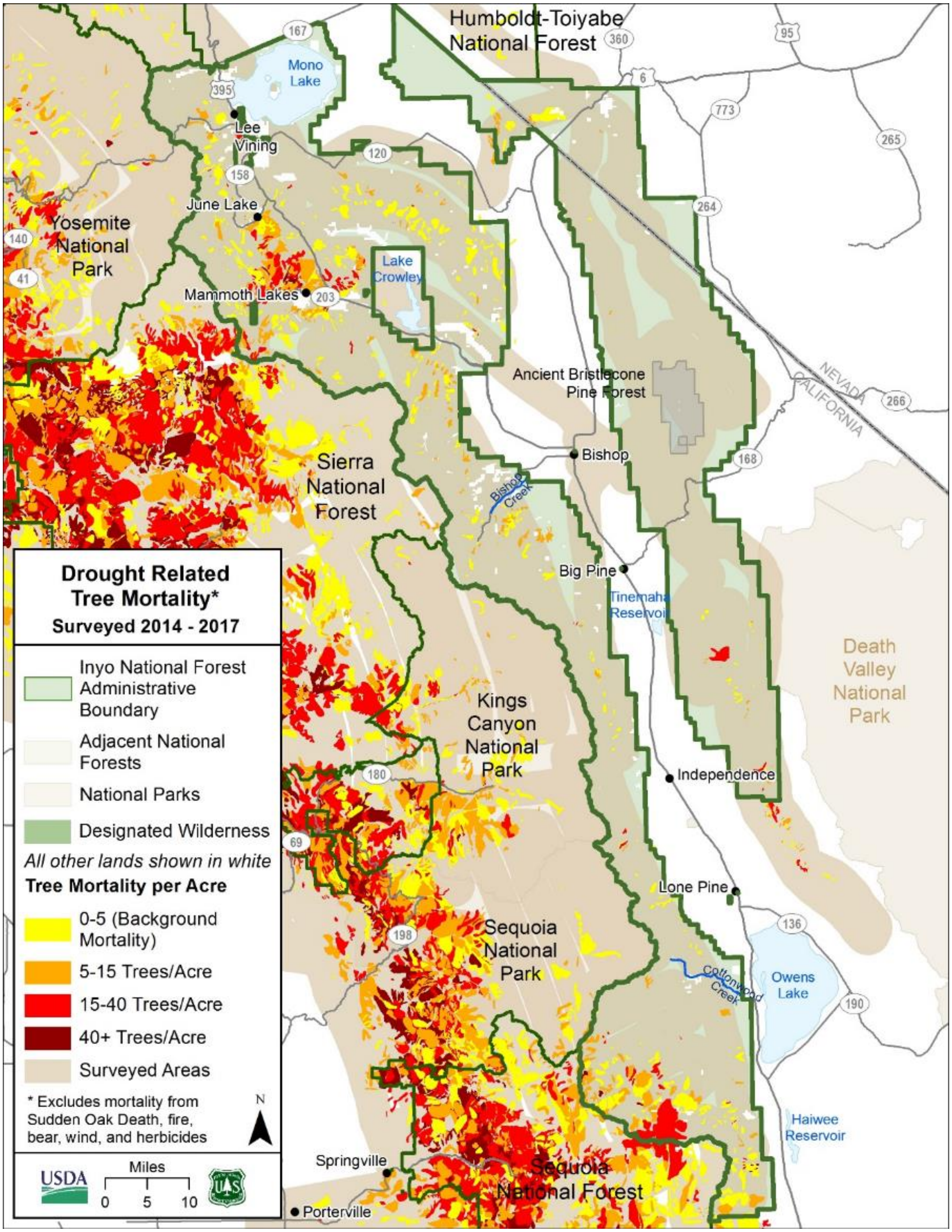

Figure 9. Drought and insect-related mortality through 2017 in the eastern Sierra Nevada based on aerial detection surveys

Nonnative Insects and Diseases

The most damaging conifer pathogen in California, white pine blister rust was introduced to the west coast of North America in 1910 on infected imported plant seedlings. White pines are all susceptible to white pine blister rust in laboratory studies, but only sugar pine and western white pine have been confirmed with infections so far. Recent surveys of white pine blister rust have found very low incidence in the southern Sierra Nevada national forests (Maloney 2011). However, preliminary research from Sequoia and Kings Canyon National Parks found a doubling to 45 percent white pine blister rust infection levels in western white pines since the initial survey conducted in the early 1990s (Cahill 2013). The pathogen has not yet been found on eastside forests, but is continually expanding its range as observed in northwestern forests and Rocky Mountains. It continues to be a serious threat to white pines as climate conditions change and pathogens are easily transported through other pathways.

Expected Trends

Forest Health Monitoring risk maps (USDA Forest Service 2012a) show substantial risk of increased tree mortality (greater than 25 percent basal area lost) in the next 15 years due to bark beetles and other pest complexes (see maps in the Insect and Pathogen supplemental report). Data from these maps are summarized in table 9.

Droughts may become frequent and prolonged, and mortality will likely be proportional (Smith 2007). A warming and drying climate is expected to greatly increase the likelihood and risk of widespread and elevated insect and pathogen outbreaks (Fettig 2012).

Table 9. Summary of percentage of area at risk by basal area loss categories for the Inyo National Forest

Percent Basal Area Loss (percent)	Percentage of Area at Risk
1-4	10%
5-14	23%
15-24	14%
>25	53%

Environmental Consequences to Insects and Pathogens

Consequences Common to all Alternatives

All forested lands are affected by native insects and diseases. With the exception of a few introduced insects and pathogens, forests in the Sierra Nevada have the same insect and disease associates they had 100 to 150 years ago. Every tree species has its complement of pest hosts that cause natural mortality and generate small-scale ecosystem disturbances. As opportunists when favorable conditions arise, bark beetle-associated activity can be expected to increase if current forest conditions remain unchanged or limited. If bark beetle attack potential is not mitigated, stands categorized as high risk may experience undesirable levels of dead and dying trees during times of drought or other conditions that are conducive for insect population growth and expansion. Climate change, urbanization, large wildfires, and chronic elevated ozone pollution levels all influence forest resilience to insects and pathogens in addition to the proposed restoration treatments.

All alternatives have measures to limit the spread and infection of nonnative invasive insects (including those species not yet present in the Sierra Nevada such as goldspotted oak borer) and pathogens. This includes white pine blister rust.

Consequences Specific to Alternative A

Alternative A would have limited areas of restoration (table 4, page 83), including thinning from mechanical treatment or moderate intensity prescribed fire that would reduce the risk of bark beetle outbreaks. There would continue to be large areas at high risk of bark beetle-caused tree mortality beyond desired condition levels. Trees in dense stands, outside of the natural range of variation, would continue to experience high tree-to-tree competition for water and other essential resources. Water stress from dense, competing trees as well as potential drought, compounded with pathogens such as root disease or dwarf mistletoes would combine to further weaken trees, inciting secondary insect attacks (beetles). Current elevated levels of tree mortality would be likely to continue now or develop again in the near future with drought and temperature increases.

Consequences Specific to Alternative B

In alternative B, more forested acres are proposed to be treated whether with mechanical thinning, prescribed fires, and wildfires managed to meet resource objectives (TERR-FW-OBJ-01 to 03; MA-RCA-OBJ-01; SCEN-FW-OBJ-01; SPEC-SG-OBJ-01). This reduction of overall tree density across the landscape should reduce the likelihood of bark beetle infestations growing to epidemic levels within treated areas. This is because increased restoration treatment rates under alternative B would reduce stand densities, increase heterogeneity, and restore tree composition to conditions aligned with the natural range of variation (TERR-MONT-DC-01TERR-DMC-DC-01 to 06; TERR-RFIR-DC-01 to 07; TERR-PINY-DC-01 to 05; TERR-JEFF-DC-01 to 07; TERR-LDGP-01 to 10). Reducing density would reduce moisture stress to individual trees (trees have greater capacity to resist insect attack via pitching response) and reduce the likelihood that stands would support pathogen spread and insect eruptions. Greater heterogeneity in the forests, species diversity, and variations in spacing and structure may limit pathogen spread through root-to-root contact or canopy-aided dispersal. In alternative B, increased mechanical treatments along ridges and roads would be particularly effective at enhancing the resilience of forest ecosystems to undesirable impacts by insects or pathogens, especially in low- to moderate-elevation forests such as mixed conifer, ponderosa pine, and Jeffrey pine forests (see management approaches discussed in “Fire Trends” section).

Consequences Specific to Alternative B-modified

The consequences of alternative B-modified would be similar to alternative B, but there would be a marginally higher restoration treatment rate (specifically mechanical thinning and wildfires managed to meet resource objectives) under alternative B-modified. As a consequence, the overall susceptibility of treated forest stands (Jeffrey pine and dry mixed conifer) to bark beetle attack and outbreaks will be slightly lower in alternative B-modified compared to alternative B. Increased treatment rates will result in more stands with reduced stand density, increased structural heterogeneity, and other ecological conditions consistent with the natural range of variation. As in alternative B, lower stand densities in alternative B-modified would reduce tree moisture stress, enhancing the capacity of trees to resist insect attack and potentially reduce pathogen incidence in healthy trees.

Consequences Specific to Alternative C

Alternative C would have lower levels of mechanical thinning than alternative A with more emphasis on prescribed burning and wildfire managed to meet resource objectives (table 4, page 83). As a result, there would continue to be high levels of risk to bark-beetle-associated mortality unless the burned areas are extensive and of moderate intensity with substantial reduction in tree densities. If the focus of mechanical treatments is removing smaller diameter trees, limited changes to current forest conditions may serve to perpetuate the risk of insect and pathogen outbreaks in many areas. The exception includes the wildland-urban intermix defense zone, where mechanical treatment rates under alternative C would be similar to alternative A and some reduction in stand density would occur nearest to communities. There may be increased levels of bark-beetle infection in areas treated with burning alone, particularly when it occurs in dense stands where the trees are already stressed (Fettig et al. 2008, Fettig and McKelvey 2010).

Consequences Specific to Alternative D

Alternative D would have similar consequences as alternatives B and B modified but over substantially more area. Increased levels of thinning, prescribed fire and wildfire managed to meet resource objectives proposed in alternative D (table 4, page 83) would result in decreased levels of bark beetle activity in forest ecosystems. Alternative D would increase the pace and scale of forest restoration toward desired conditions and greatly improve forest resilience over larger spatial and longer temporal scales. Insect and pathogen outbreaks under this alternative would be more limited to localized levels that closer resemble historic conditions (Savage 1994). Trees in restored stands would have improved access to water and resources and lower competition for water. This would allow trees in restored stands to more rapidly recover after drought or wildfire, and gradually adjust if climate conditions continue upward trends (North 2012b, Fettig et al. 2007).

Cumulative Effects

There can be cumulative effects resulting from management of nearby lands under different ownerships. Insects and pathogens can increase on adjacent lands and spread to national forest lands. Similarly, insect and pathogen outbreaks can spread from national forest lands to adjacent lands.

There are three different types of land ownership adjacent to national forest lands, each with varied capacities and likely forest management approaches that affect insect and pathogens. First, there are other Federal lands including Sequoia and Kings Canyon and Yosemite National Parks. Second there are urbanized or developed areas. Third, there are larger private land owners that actively manage forests including private timberlands and utility companies.

There is an emphasis on prescribed and managed fires and little mechanical thinning in national parks. This could result in different elevated mortality levels and potential spread to national forest lands, but to date mortality levels have been similar or less (see figure 9). It could be that elevated mortality on national forest lands has resulted in elevated mortality levels on national park lands.

Forests on small private lands are often very dense, because trees are retained as natural screening or shading. There is a higher likelihood of root damage near structures and roads that can increase susceptibility to insect and pathogen attack; this may increase the spread to national forest lands but the amount of area in this condition is small and limited to some forested areas around Mammoth Lakes and June Lake.

Analytical Conclusions

Common consequences for all alternatives are such that (native and invasive) insect and disease activity would continue to persist, and effects to trees would occur regardless of treatments under all alternatives. The differences lie in the levels of intensity and severity of outbreaks; in particular, levels of tree mortality. Eastside and westside forests of the Sierras will experience varying degrees of mortality as insects and pathogens continue to target stands of highest risk (stands with highest stand densities and greatest moisture stress).

While alternatives B and B modified allow for restoration treatments on the landscape, including the use of mechanical thinning, wildfire and prescribed fires, climate change projections indicate that warmer, potentially drier temperatures in the next few decades may occur before much of that restoration is completed. With the greater rate and amount of restoration, alternative D may more rapidly prepare for these conditions. The trend of large-scale wildfires on an annual basis in California has increased urgency for developing resiliency and resistance to elevated forest pest levels and in current forest structures.

Management direction of alternatives A and C would not sufficiently reduce stand density, structure, or microsite conditions that are conducive to bark beetle-associated tree mortality, especially during periods of drought (Smith 2007). Ponderosa pine stands in California need lower stocking thresholds to prevent losses beyond background levels (Oliver 1995). The level of treatments proposed for alternative D followed by alternatives B and B modified would be most effective to prevent bark beetles, such as western pine beetle, from reaching regional and bio-regional scales as is currently happening in the southern Sierra Nevada.

Combined Effects of Climate, Fire, Insects, and Pathogens

Terrestrial Ecosystems

Climate, fire, insects and pathogens all influence and interact with each other. Various aspects of how they influence each other are discussed in the individual subsections above. It is important to also consider them as a whole, since they all affect vegetation and are affected by vegetation condition. For the forest plans, the primary means of altering ecosystems is management of vegetation condition. In this subsection, the cumulative effects and analytical conclusions for climate, fire, and insects and pathogens on vegetation condition and management are considered. More detail on the combined effects of climate, fire, insects and pathogens is described in the Vegetation Resilience supplemental report.

Figure 10 shows how each of these agents of change influence each other and vegetation condition. In the diagram, the direction and weight of arrows show how each agent of change and vegetation relate to each other. Although the way fire is managed may vary, fire will occur regardless at some point in time because the plan areas are dry and fire prone, with regular ignition sources (lightning and human-caused).

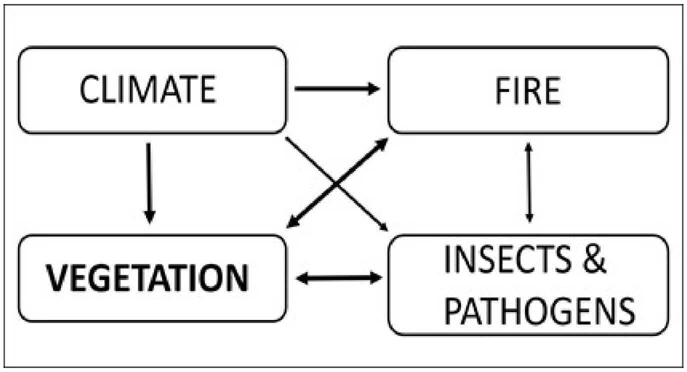

Figure 10. Conceptual diagram of the interaction between climate, fire, insects and pathogens, and vegetation

Starting with vegetation and moving clockwise around the diagram:

- Vegetation is in bold, because this is the only aspect of ecosystems that can be directly influenced by forest plan direction.
- Climate influences vegetation, fire, and insects and pathogens directly through temperature and moisture changes.
- Fire influences vegetation, and vegetation influences fire. The arrow between fire and vegetation is bold because there is a strong influence of vegetation on fire and vice versa.
- The arrow that goes from fire to insects and pathogens is thinner because most of the influence of insects and pathogens is through the changes it causes in vegetation. However, fire can also influence insects and pathogens by potentially making trees more susceptible to bark beetle or pathogen activity. Conversely, insects may increase fire severity and extreme fire behavior, especially if trees experience high levels of beetle-related mortality and are in the red stage (that is, the first few years following beetle attack; Hicke et al. 2012, Jenkins et al. 2008, Jenkins et al. 2012, Stephens et al. 2018). Recent observations of wildfires in the southern Sierra Nevada have confirmed these patterns of increased fire behavior (increased torching, fire intensity, and fire spread rates) in areas of recent high levels of tree mortality (Reiner et al. 2017).
- The changes insects and pathogens have on vegetation also affects fuels, which then influences fire (Hicke et al. 2012, Stephens et al. 2018). Moreover, the density and biomass of vegetation (trees) influences insect and pathogen populations and dispersal through the availability of host species, especially with drought and climate change (Preisler et al. 2017, Young et al. 2017).

These interrelationships illustrate that the effects of climate, fire, vegetation, and insects and pathogens are complex, especially in forest ecosystems with a frequent fire regime (Stephens et al. 2018). As described above in the previous subsections, there has been and will continue to be a trend of warming climate, increased fire, and increased insect, pathogen, and disease levels and vegetation-related mortality. Effects on vegetation are magnified where vegetation structure and composition are outside the natural range of variation. There is a large proportion of the middle and lower-elevation landscapes that are outside the natural range of variation and are highly departed from the vegetation desired conditions (see the “Terrestrial Ecosystems” section). Denser vegetation has a lower resilience to climate change, fire, insects, and pathogens. Composition that has shifted toward dominance of less drought- and fire-tolerant species has decreased resilience. Nonnative plant species may increase with climate change and changing fire, especially in eastside sagebrush, pinyon-juniper, and desert ecosystems. This is beginning to cause a negative feedback with increased nonnative plant invasions causing more fire, which causes more invasions.

Analytical Conclusions

Three factors most important in changing ongoing and reasonably foreseeable future effects of climate, fire, insects, and pathogens on vegetation condition include the pace, scale, and intensity of restoration to change vegetation conditions toward desired conditions. The alternatives vary in the pace, scale, and intensity of restoration, particularly in the low and mid-elevation areas including mixed conifer, Jeffrey pine, pinyon-juniper, and sagebrush vegetation types.

Alternative D has the greatest amount of restoration treatment (pace), across the largest area (scale; 30 to 60 percent of lower and mid-elevation landscapes dominated by forest, sagebrush, and pinyon juniper ecosystems), with the greatest certainty of moving vegetation toward or achieving desired conditions (intensity) in treated areas. This would be through extensive thinning, prescribed fire and more opportunities for wildfires managed to meet resource objectives. Up to half of the landscapes that are most departed from desired conditions (see “Terrestrial Ecosystems” section) would be restored within the next 10 years in alternative D and be more resilient to fire, climate change (hotter droughts), insects, and pathogens.

Alternatives B and B-modified have the second greatest amount of restoration, but restoration efforts would be concentrated in a less extensive portion of the national forest, in about 30 percent of montane forest, sagebrush, and pinyon-juniper woodlands. Some of the prescribed fire objectives in alternatives B and B-modified would not be achieved because of more limitations on prescribed fire in riparian habitat. Most of the landscape would continue to have low resilience to climate change, fire, and insects and pathogens.

Alternatives A and C would likely have the lowest pace, scale, and intensity of restoration because they have the least amount of active mechanical and potentially prescribed fire treatments. Although there is more planned prescribed fire in alternative C, there would be less mechanical treatment and less resulting restoration of ridges and roads that could be used to “anchor” off of for large prescribed fires.

Overall, alternative D would alter vegetation conditions to the greatest extent by restoring vegetation structure, composition, and function, and limiting the negative impacts of climate change, large high-intensity fire, and elevated insect and pathogen levels. Alternative B would restore some landscapes to the point where negative impacts of stressors would be moderated, but almost half of the landscape (40 to 50 percent) would be still be vulnerable under this alternative.

Revision Topic 1: Fire Management

Introduction

Wildfire has and will continue to affect vegetation and ultimately be a primary driver of change to ecosystems in the Inyo National Forest. Wildfire has been a vital part of the Sierra Nevada range for centuries. Many of the ecosystems that make up the area in and around the Inyo National Forest have been shaped by the way fire moved across the landscape in the past as well as by the lack of fire in recent history. The historic role fire plays in reducing fuels was nearly eliminated with 100 years of effectively suppressing fires. Fire management has gone through several changes over the last few decades; transitioning from a more suppression-focused approach to moving toward a more managed approach to restore ecological integrity and provide protection for valued natural resources and assets within and around national forests.

Decades of fire suppression, buildup of vegetation and forest debris, and more recently, drought and climate change have caused wildfires to grow larger and become more destructive (see the “Climate Change” and “Fire Trends” sections). Limited funding for prevention programs and many challenges to implement fuel reduction projects have resulted in limited progress toward reducing the compounding effects of decades of suppression and an increase in the frequency of large, high-intensity wildfires. The number and extent of wildfires in the western United States each season is driven by natural factors such as fuel availability, temperature, precipitation, wind, humidity, and the location of lightning strikes, as well as human factors. It is well known that climate fluctuations significantly affect these natural factors, and thus the severity of the western wildfire season, at a variety of temporal and spatial scales (Westerling et al. 2003). Unwanted wildfires burning at high intensity and under extreme conditions and within the wildland-urban intermix have the potential to damage forests and wildlife habitat, negatively affect stream and watershed quality, reduce air quality with increased smoke, and destroy homes and communities. Other wildfires burning under more desirable conditions (environmental conditions such as a combination of temperature, relative humidity, wind speed and direction, and air mass stability that influence vegetation moisture and fire behavior) provide an opportunity to be managed to meet resource objectives.

The increase in wildfires in western U.S. forests is related to warmer spring and summer temperatures, reduced precipitation associated with warmer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons in some middle upper elevation forests. These conditions can be attributed to climate change (Westerling and Bryant 2008). As the climate becomes warmer and drier, vegetation becomes drier, stressed, and more susceptible to insects and disease and is more likely to be consumed by fire. Traditionally, fire season in California was from May to September. Recently, fires have occurred throughout the year more regularly, resulting in an almost year-round fire season. Not only are fires occurring more frequently outside of the traditional fire season, they are much more intense causing more severe and long-lasting damage to the vegetation and soils. Large-scale and long-duration droughts may occur and will increase the potential for fires to burn larger and with higher intensity than desired. The result of this type of changing climate is likely to be larger, more damaging wildfires with fewer opportunities to manage wildfires to meet resource objectives or to conduct prescribed burns.

Increased amounts and duration of smoke produced from large wildfires is likely to continue to impact population centers, including those long distances from the fire. Increases in wildfire smoke emissions may have detrimental impacts on air quality and, combined with a growing population, may result in increased population exposure to unhealthy air pollutants (Hurteau et al. 2014). Wildfires may occur during times of unfavorable atmospheric conditions resulting in a compounded impact. However, substantially increasing the amount of fire restored to the landscape will require societal trade-offs, such as accepting more smoke from prescribed fires and managed wildfires versus continuing to live with high wildfire risk. When evaluating these tradeoffs, the costs to society, such as short-term versus long-term air quality impacts, must be considered in the context of doing nothing (Hurteau et al. 2014). Emissions from prescribed fires are typically lower than those from wildfires burning the same area (Wiedinmyer and Hurteau 2010). Prescribed fires are planned with careful consideration of smoke to limit human health impacts, impacts to transportation corridors, and smoke-sensitive populations. Atmospheric dispersion (how pollutants disperse throughout the atmosphere) influences smoke behavior. By limiting the amount of fuels available to wildfires, impacts to air quality from future wildfires will likely be reduced. Since wildfires that are managed to meet resource objectives burn over many days, they may burn during unfavorable conditions such as during high ozone days; however, long-term benefits exist as fuels available for future wildfires are diminished. See the “Air Resources” section for more information.

Wildfire suppression costs have increased significantly over the last decade (Ecology, Fire, and Conservancy 2015). This fact, coupled with decreasing or static budgets for fuels management, presents serious challenges to fire managers and increases the risk of continued large and high-intensity wildfires. A way to address these issues is to use a risk-based approach to guide the future management of wildfire. This is discussed further in the next section.

Wildland Fire Management

Background

Wildland fire management includes the strategies and actions used both before and during wildfires. Management of wildland fire (wildfire and prescribed fire) influences whether fire effects are beneficial or cause negative impacts to values such as water quality, air quality, habitat, recreation areas, timber resources, or communities. Fire management begins with pre-planning; using tools to aid in the decision-making process. These tools include pre-season meetings with partners, monthly and seasonal outlooks for climate patterns, fuel moisture trends, energy release component trends, smoke dispersion forecasts, fire behavior modeling, and risk assessments. Using these tools, decision makers identify the current and expected conditions for the season, communicate with partners, and are prepared when deciding what wildfire response to use. Wildfire responses include a spectrum of strategies (often referred to as “suppression strategies”) that include full suppression, confine and contain, and monitoring. Full suppression is a management action used to extinguish or confine an unwanted wildfire at its discovery. Confine and contain is a strategy that uses natural or constructed barriers or burn out of unburned areas to slow or stop fire spread. Monitoring is an active strategy that involves monitoring the fire behavior, weather, and smoke while creating contingency plans for different outcomes of fire spread.

Managing Wildfires to Meet Resource Objectives

The term used for naturally ignited wildfires that are managed to reduce fuels and improve ecosystem health is “manage wildfires to meet resource objectives.” This term is used throughout the document. Human-caused fires and trespass will be managed to achieve the lowest cost and fewest negative consequences with primary consideration given to firefighter and public safety and without consideration to achieving resource benefit (FSM 5130.3).

Managing a fire to meet resource objectives is active management, not passive, using a confine and contain or monitoring strategy. Managing wildfires to meet resource objectives is a strategic choice to use unplanned lightning-caused ignitions to achieve resource management objectives and ecological purposes under specific environmental conditions. Environmental conditions consist of a combination of temperature, relative humidity, wind speed and direction, and air-mass stability. These factors influence vegetation moisture and fire behavior and are determined annually during the pre-planning phase of fire management. The benefits of managing wildfires to meet resource objectives include reducing fuels so that future fires burn in that area with lower intensity, lower impacts, and reduced smoke, are more manageable, and pose less threat to communities. Managing wildfires to meet resource objectives allows fire to resume its natural role in the ecosystem under pre-identified objectives and conditions. By allowing this to occur, the results are a healthier ecosystem. Fire can create a diversity of habitats, cycle nutrients back into the soil, and reduce dense areas of vegetation, which improves vegetation health.

Fuel Reduction Treatments

Fuel reduction treatments include prescribed fire and mechanical treatments which are designed to change the amount, configuration, and spacing of live and dead vegetation. Prescribed fires are fires intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific objectives. Mechanical treatments are changes made to vegetation composition and structure (by cutting, thinning, or pruning) and changes made to forest fuels to reduce fire hazard. Mechanical treatments are often followed up with prescribed burning. The costs, environmental impacts, and effectiveness of different fuel treatment types vary. The desired outcomes of fuel reduction treatments are less intense fire behavior and reduced severity during wildfires, moving the area toward the natural range of variation, less tree mortality after a fire, and reduced amounts of smoke. Strategically located fuel reduction treatments also provide more opportunities to proactively manage the size and costs of future wildfires.

The Challenges of Wildfire Management

Managing wildfires can be difficult because of smoke impacts, proximity to human communities, and liability and cost constraints (Quinn-Davidson and Varner 2012). In addition, policy and management requirements also factor into how wildfires are managed. For example, Forest Service fire policy (Forest Service Manual 2320) states that in wilderness, fire should be allowed to play its natural role as nearly as possible but this presents challenges if the fire has the potential to burn outside of wilderness areas and threaten communities or other resource values. Mechanical treatments have their own set of legal, operational, and administrative constraints, limiting the location and extent of treatment (North et al. 2015), including exclusion in wilderness. Forest and wildland fire managers in the southern Sierra Nevada currently have the ability to more holistically manage wildfire by incorporating the management of wildfires to meet resource objective within the forest plans (Meyer 2015a).

Holistic wildland fire management can be thought of as an approach that simultaneously considers the role of fire in the landscape, the ability of humans to plan for and adapt to living with fire, and the need to be prepared to respond to fire when it occurs. There are multiple factors that make it difficult for forest managers to incorporate a more holistic approach into fire management. Some of these factors are risk aversion, sociopolitical pressures, and a resulting propensity to choose the status quo fire response of suppression. These factors do not improve resource conditions and create a positive feedback loop; this is known as the "fire paradox," in which aggressive suppression today leads to accumulation of fuels and worse fires in the future (Arno and Brown 1991). This in turn leads to continued excessive suppression expenditures (Thompson et al. 2013). Society's expectation that fires are aggressively suppressed is well ingrained, regardless if the fires might meet the objectives of current policy.

National Cohesive Wildland Fire Management Strategy

Increasingly, wildfire management is being viewed as a form of risk management, with a corresponding increase in analytical rigor and alignment with risk management principles (Calkin et al. 2005). Through planning, risk analysis, and collaboration between stakeholders, a broad coalition led by the Western Governors' Association and Federal land management agencies (USDA Forest Service and Department of Interior agencies) developed the "National Cohesive Wildland Fire Management Strategy" to establish a national vision for fire management (referred to hereafter as the "Cohesive Strategy"). This strategy defines goals, describes wildfire challenges, identifies opportunities to reduce wildfire risk, and is the basis for the fire management strategies in the alternatives considered for revising the forest plans.

There are three primary goals to the Cohesive Strategy: (1) restore and maintain landscapes, (2) create fire-adapted communities, and (3) respond to wildfires safely and effectively. A risk-management approach serves as the foundation for all fire management activities. To restore and maintain resilient landscapes, risks and uncertainties relating to fire management must be understood, analyzed, communicated, and managed as they relate to the cost of doing or not doing an activity. To create fire-adapted communities, it is imperative to work with partners and use a risk management approach to identifying communities at risk and help protect these communities. A safe and effective response to wildfire requires moving beyond an emphasis on suppression and considering a more holistic way to meet resource objectives.

Funding is limited and there are not enough resources to reduce fuels with mechanical or prescribed fire treatments alone to change fire dynamics on a landscape scale. Managing wildfire to meet resource objectives is the most effective and efficient way to reduce fuels, effectively reduce the risk to communities and resources (such as water sources or habitat), and restore and maintain landscapes. Areas where fires were historically frequent can derive ecological benefits from fires; vegetation health is improved, habitat is improved, and species benefit.

Wildfire Risk Management

Wildfire risk management is the process whereby management decisions are made and actions are taken concerning control of risk and acceptance of remaining risk. It involves identifying, assessing, and prioritizing risks followed by the coordinated and economical application of resources to minimize, monitor, and control the probability or impact of unfortunate events (Thompson and Calkin 2011). Wildfire risk management is often supported by a scientific assessment that can be used to determine where individual wildfires are likely to have negative or positive outcomes. It is based upon a detailed quantitative analysis of the location of values at risk (such as water sources, communities, or recreation sites) and the likelihood of fire starts (often called "ignitions"), fire spread, and fire intensity. For the forest plan and alternatives analyzed in this environmental impact statement, a wildfire risk assessment was conducted to evaluate the alternatives and develop science-based management areas for strategic fire management zones. The strategic fire management zones for the alternatives are described briefly in chapter 2 and in more detail below. In the next section, a brief description of the underlying analysis for the wildfire risk assessment is described. This includes what values at risk were included and the relative ranking of each. For more detailed information about the risk assessment, see specialist reports in the project record.

Fire Management Considerations

A strategy to address the need to change fire management includes recognizing constraints, acknowledging the ecological role of fire, aligning procedures with policy, and managing risk to the extent possible.

Recognize Constraints to Fire Management

Recognize that in general there are a very large number of burnable acres of National Forest System lands that cannot be actively managed by mechanical means, and an even larger number that cannot be economically treated with prescribed fire. Appropriately managing wildfire in places with an opportunity to obtain resource benefits and a low risk of potential damages may be the only way in many areas to increase the pace and scale of ecosystem restoration activities. Continued risk-informed management of wildfire would also need to include a method to maintain areas once restoration has occurred.

Acknowledge the Ecological Role of Fire

Acknowledge the ecological role of fire but also be cognizant of the fact that many fire regimes in the southern Sierra Nevada are currently highly altered and will stay altered because many sociopolitical concerns affect how wildfires are managed and how fuels are treated. The goal of ecological restoration is not to return the landscape to its historical fire regime (because such an outcome is not realistic with the extent of human influence), but instead to have forests that are sustainable and resilient to expected changes over time.

Align with Policy

The 2009 “Guidance for Implementation of Federal Wildland Fire Management Policy” directs Federal agencies to manage wildfires to accomplish protection and resource objectives. A wildfire may be concurrently managed for one or more objectives and these can change as fire spreads across the landscape. Objectives for wildfires are affected by changes in fuels, weather, and topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives. This guidance requires land managers to address the location and conditions under which resource benefits and protection objectives can be met in forest plans.

The “wildfire management continuum” was created to visually depict how wildfires may be managed for one or more objectives (Thompson et al. 2016). The basics of the wildfire management continuum can be described according to four dimensions (figure 11). Using risk management results according to these dimensions, allow for the landscape to be zoned according to broad categories. The strategic fire management zones highlight where the objectives can be met under a wide range of fire season conditions.

- The length (side to side) of the continuum shows the spatial component, or the location on the landscape. The location also affects the mix of objectives: on the left, it favors protection objectives, whereas on the right it favors resource objectives.

- The width (up and down) of the continuum illustrates the different social, ecological or environmental conditions affecting the mix of objectives. On the top, protection objectives prevail, whereas on the bottom resources objectives are easier to obtain.
- The colors depict the range of objectives, taking in the combination of both location and conditions. Red (upper left) represents how the combination of conditions and landscape location can experience higher risks to communities or ecological resources, which result in protection as the predominate objective. Blue (lower right) has the combination of low-risk conditions and landscape location that make managing for resources the primary objective. The colors also represent the net value change to natural resources and community assets; red indicates a negative change (damage) while blue indicates a positive change (benefit). The fire management response is to protect from potential damage and to obtain benefit. As risk is lowered on the landscape, more positive net value change opportunities exist over more locations and conditions, therefore increasing the ratio of blue to red.
- The teeth on each end of the continuum indicate that it wraps around to form a cylinder. A wildfire on the far left could be near an area with high risk and management of that portion of the fire would be to meet protection objections. Whereas, a fire on the right side being managed primarily for resource objectives may change to a fire managed for protection objectives due to environmental changes that caused it to grow and threaten resources and assets.

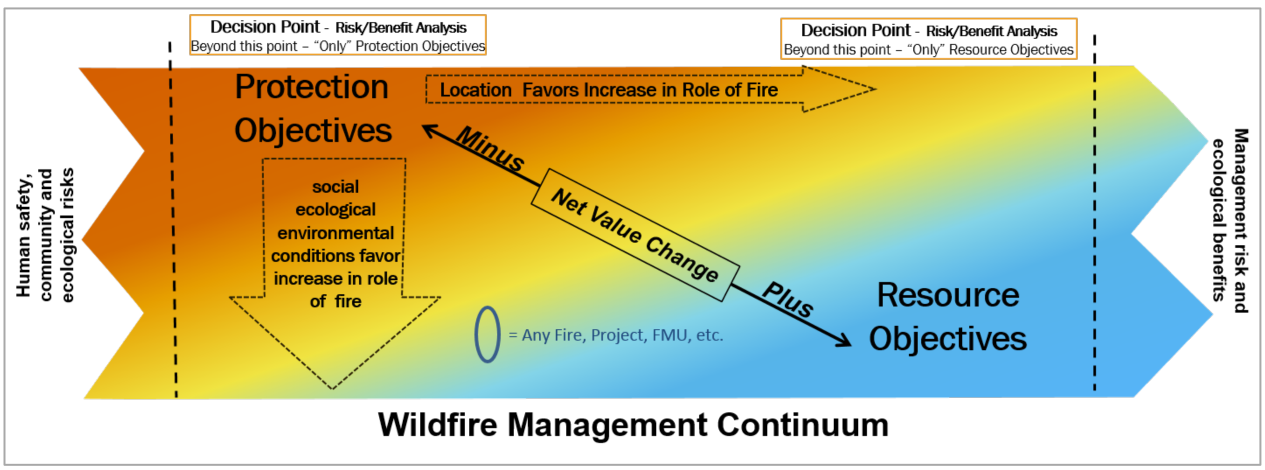

Figure 11. The wildfire management continuum

Manage Risk

Effective management of wildfire addresses the nature of wildfire and its contributing factors, recognizes the positive and negative consequences of fire, addresses uncertainty, and develops plans that reduce the chances of catastrophic losses (USDA and USDI 2014). Forest and fire managers manage risk, both in the short and long terms. If the potential positive and negative consequences of fire are recognized, and management actions to obtain positive outcomes are matched, then in the long term the risk to communities and assets will be reduced; fire will be restored as an ecosystem function to the landscape; and smoke impacts to communities will be reduced. Also, risks and uncertainties relating to fire management activities must be understood, analyzed and communicated.

Synopsis

During any wildfire, fire managers must consider firefighter and public safety, risk to property, fire management resource availability, national and regional priorities, costs, and potential resource benefits in all wildfire management decisions. A wildfire may be concurrently managed for one or more objectives and these can change as the fire spreads across the landscape. Objectives are affected by changes in fuels, weather, topography; varying social understanding and tolerance; and involvement of other governmental jurisdictions having different missions and objectives (Guidance for Implementation of Federal Wildland Fire Management Policy, February 2009). Forest Service policy dictates that all wildfires will have a protection objective (2015 "Interagency Standards for Fire and Fire Aviation Operations"). Wildfires may also have resource objectives that are outlined in the forest plan.

Analysis and Methods

A wildfire risk assessment for the Inyo National Forest was conducted using the methods outlined in the publication "A Wildfire Risk Assessment Framework for Land and Resource Management" (Scott et al. 2015). The wildfire risk assessment identified areas of risk, which helped in the development of designating the strategic fire management zones. Spatial data is used in the assessment to analyze where resource objectives and protection objectives can be met.

For this analysis, FSim, a computer program for large-fire simulation, was used to quantify wildfire hazard across the landscape. FSim is a comprehensive fire occurrence, growth, behavior, and suppression simulation system that uses locally relevant fuel, weather, topography, and historical fire occurrence information to estimate the contemporary likelihood and intensity of wildfire across the landscape (Finney et al. 2011). A geographic information system model combined the FSim outputs and highly valued resources and assets (HVRAs) to identify the strategic fire management zones for the alternatives. Zones were evaluated and refined using local knowledge from fire managers, fuels specialists, and other forest managers.

A major part of a wildfire risk assessment is to have a good indication of where potential damages and benefits can occur. This is more than just locating the highly valued resources and assets, it is locating where they have the potential to be positively or negatively affected considering the likelihood of a wildfire occurring and the intensity at which it would likely burn. The two main indicators are location (where the potential damages and benefits to highly valued resources and assets are located) and source (where the wildfire ignitions of these potential damages and benefits start). The technical measure of the potential damages and benefits for location and source is determined by the net value change and is documented in the "Southern Sierra Nevada Wildfire Risk Assessment" report in the project record.

Highly valued resources and assets are a combination of natural resources and community assets whose value could potentially be affected either positively or negatively by fire. A requirement for highly valued resources and assets is that they must be spatially identified. Once highly valued resources and assets were categorically identified and mapped, resource specialists identified what the potential response to fire would be for each category. Next, the Forest Supervisor for the Inyo National Forest determined the relative importance between the highly valued resources and assets (table 10).

Table 10. Example highly valued resources and assets (HVRAs) and their relative importance values

Highly Valued Resources and Assets (HVRAs)	Relative Importance (max. 100)
Human habitation – (classified into 3 sub-HVRAs) High-density human habitation, moderate-density human habitation, and low-density human habitation[1]	97
Major infrastructure – (classified into 4 sub-HVRAs) Electrical power transmission lines, non-hydroelectric power plants, communication sites, hydroelectric power plants	83
Watershed resources – (classified into sub-HVRAs) based on number of people served (Forest to Faucets[2]), vegetation, slope and erosion potential	80
Critical terrestrial habitat (classified into sub-HVRAs) based on 4 habitat types: modified California spotted owl,[3] northern goshawk, and greater sage-grouse, and different species type and size of trees	78
Timber resources – 3 groups of tree species and size (classified into 6 sub-HVRAs) based on access (terrain steepness and access from road)	74
Inholdings – include State forests and private timber lands	67
Recreation and administrative infrastructure – (classified into 2 sub-HVRAs); Low and high developed sites	65
Visual resources - scenic byways	60
Vegetation condition class – (classified into 15 sub-HVRAs) based on biophysical settings, succession class, and relative abundance	50

1. Additional egress routes were evaluated within the high density human habitation asset
2. Forests to Faucets is a reference for how the number of people served by watershed was determined (see http://www.fs.fed.us/ecosystemservices/FS_Efforts/forests2faucets.shtml)
3. California spotted owl habitat was modified to only include the conifer forested portions of the Kern and San Joaquin drainages on the Inyo National Forest.

Relative importance values were developed by first ranking the highly valued resources and assets, then assigning a relative importance value to each. The most important highly valued resources and assets were assigned a relative importance value of 97 (Scale ranges from 0-100). Each remaining highly valued resource and asset was then assigned a relative importance value indicating its importance relative to the most-important highly valued resource and asset.

As previously stated, the Cohesive Strategy goals formed the basis for developing the fire management strategies in the alternatives. Using the wildfire risk assessment as a tool, the three goals from the Cohesive Strategy are evaluated as indicators for each alternative:

- **Restore and maintain landscapes through the use of wildfire.** Landscapes are resilient to fire-related disturbances in accordance with management objectives and the risk of undesired effects to landscapes is diminished. Managing wildfire to meet resource objectives is vital to meeting this goal, especially in areas where active management is limited.
- **Support fire-adapted communities.** Human populations and infrastructure within and adjacent to the national forest can withstand a wildfire without loss of life and property. Risk of wildfire impacts to communities is diminished. Assess the level of risk and establish roles and responsibilities for mitigating both the threat and the consequences of wildfire.
- **Improve safe and effective fire response.** All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions. Assessing

wildfire risk upfront is essential to safe and effective response. Risk exposure to firefighters is based on a balanced consideration of values protected and the probability of success. Injuries and loss of life to the public and firefighters are diminished.

Two measures rate how well each alternative addresses the indicators:

- **Managing Uncertainty:** Managing uncertainty aids in making more holistic wildland fire management decisions by giving decision makers needed information on potential decision outcomes and their associated risks in advance of the time when these decisions become urgent. Uncertainty is measured by how well each strategic fire management zone in each alternative categorizes the potential damages and benefits to highly valued resources and assets from simulated wildfires. A zone that captures mostly benefits would have low uncertainty while a zone with a high mix of both damages and benefits would have high uncertainty.
- **Facilitating Wildland Fire Management:** This measures the ability of each alternative to identify and enhance strategic fire management features on the landscape and provide a greater ability to enhance these features through fuel reduction and vegetation treatments.

Affected Environment

Historical Wildfires and Wildfires Managed to Meet Resource Objectives

Wildfires on the Inyo historically burned about 98,242 acres, averaging 4,678 acres a year from 1996 to 2016. The amounts fluctuate from year to year depending on conditions and the number of fire ignitions. Fire ignitions are either from lightning or human-caused sources. Over the 20 year analysis period, 861 lightning-caused fires burned approximately 61,591 acres whereas 1,275 human-caused fires burned approximately 36,651acres (figure 12).

Wildfires managed to meet resource objectives, on average totaled approximately 995 acres a year (20-year average). Per Forest Service policy, national forests are only allowed to manage lightning-caused wildfires to meet resource objectives (FSM 5130.3). While fire managers have had the option to manage wildfires to meet resource objectives, it has been rarely used.

Fuel Reduction Treatments

Mechanical treatments average approximately 2,300 acres annually (10-year average) on the Inyo National Forest. In shrublands, treatments are usually mowing or cutting shrubs with chainsaws. The treatments are often implemented in a mosaic to mimic natural patterns, retain important shrub species for wildlife, and to reduce the visual impacts. In forested ecosystems, most mechanical treatments are a combination of mechanical thinning of understory trees and mastication (shredding of woody vegetation) or piling and burning of small trees and activity-generated fuels. Most treatments are designed to reduce surface fuels so that future fires will burn with lower flames. Treatments are intended to raise the height of tree branches so flames are less likely to burn into the crowns of trees and spread rapidly. Project design criteria often include variable spacing and requirements to retain more canopy cover and to retain patches of shrubs and small or more dense trees for wildlife cover and to provide more natural scenery. This results in heterogeneity in fuels and higher fuel levels that influence the behavior of future fires within treated areas, increasing fire intensity and fire spread. In the Jeffrey pine ecosystem on the Inyo National Forest, however, treatments accomplished to date are expected to help moderate wildfire behavior, thus facilitating the use of managed wildfires to achieve resource objectives.

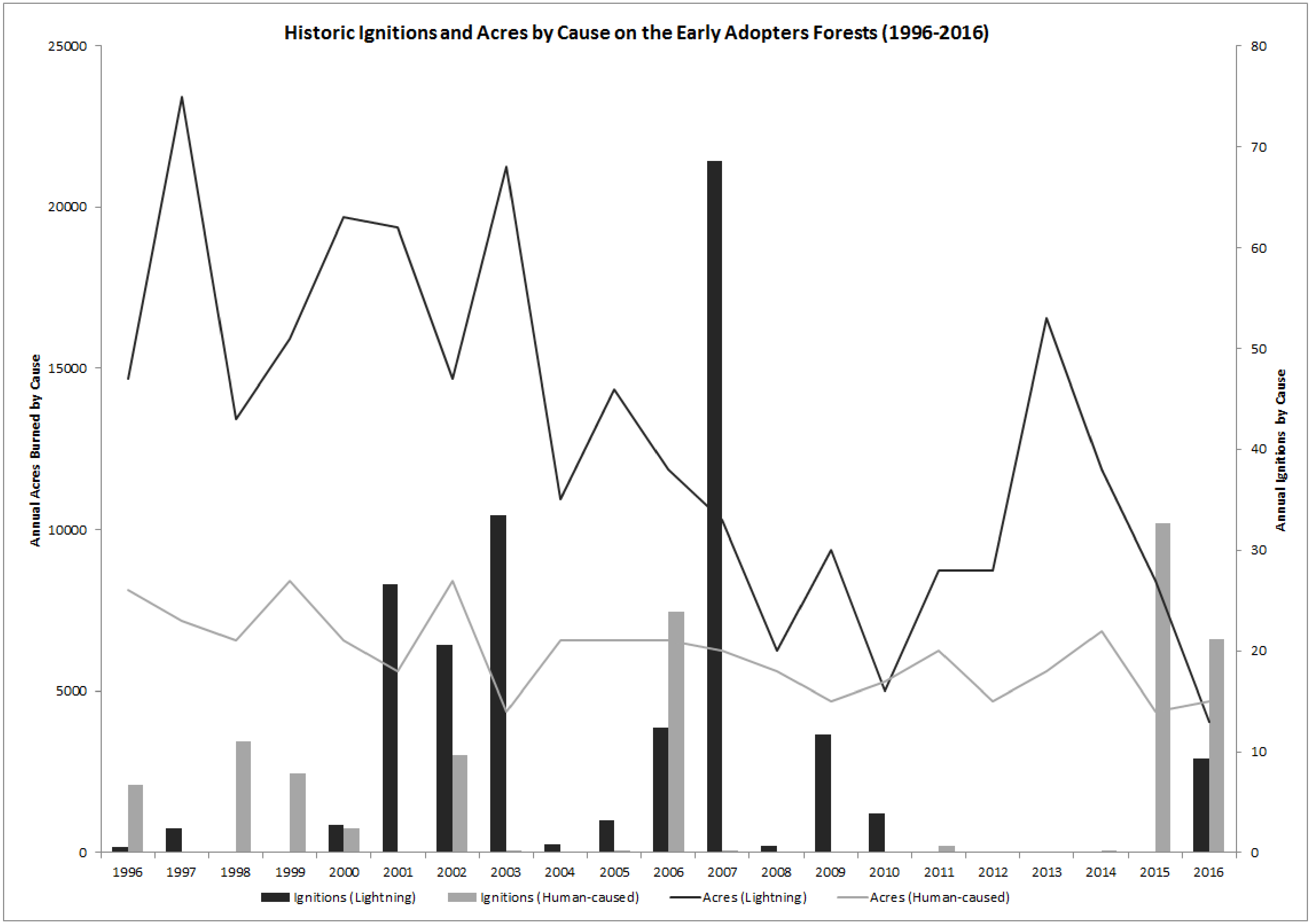

Figure 12. Historic ignitions and acres burned by cause: 1996-2016, Inyo National Forest

Prescribed fire treatments on the Inyo National Forest, on average, were approximately 1,500 acres annually (10-year average). Currently, the amount of prescribed burning is not occurring at a sufficient scale to reduce fuels to the extent that would influence large wildfires that burn at high intensity or at a pace to restore the desired fire return frequency that would restore resilience to the landscape. Most prescribed burning occurs within areas either previously mechanically treated to reduce fuels or areas that have previously been prescribed burned. Prior to a prescribed burn, a burn plan prescription is developed that determines the burn objectives, resource requirements (such as limited operating periods for wildlife and protection measures for cultural resources) and weather and fuel conditions under which the prescribed burn can be implemented. Before burning, fire managers determine if the weather and fuel conditions are within the burn plan prescription and fire management resources are sufficient to ensure the burn objectives can be safely met. Because prescribed burning is dependent upon weather and fuel conditions, seasonal timing, availability of resources, and acceptable conditions for managing smoke, some areas have been mechanically treated but have not yet been burned due to suboptimal conditions.

Fire Management Coordination

The Forest Service coordinates with local fire districts and State fire agencies, interagency partners (especially the National Park Service and Bureau of Land Management), and tribal liaisons during wildfire incidents and prior to fire season to develop prevention programs in high wildfire risk areas. Fire managers work with local communities to decide where and how to apply fuel reduction projects on Federal lands through a community wildfire protection plan. Under all alternatives, this communication and coordination would continue and propagate as fuel reduction treatments are planned on the Inyo National Forest.

Environmental Consequences of Fire Management

Strategic Fire Management Zones

The wildfire risk assessment includes the Inyo National Forest and surrounding areas to analyze fires that not only occur on the national forest, but also fires that originate on other lands and burn onto the national forest. Vegetation on the Inyo varies from desert shrubs in the lowest elevations to alpine areas on the mountain crests. In the arid portions of the national forest, sagebrush and pinyon-juniper can occur from the lower elevations and extend all the way up into the subalpine zone. Where there is more precipitation in the montane zone, Sierra type conifer forests occur. Subalpine forests usually dominated by five-needle pines occur in the higher elevations of all the mountain ranges. Alpine areas and areas characterized mostly by rock are common.

The zones used in alternative A (the current forest plan) consist of the two zones within the wildland-urban intermix: the defense zone and the threat zone; and the general forest, which consists of the area outside the urban-wildland intermix. The wildfire risk assessment was the basis for the creation of strategic fire management zones in alternatives B, B-modified, D and, in part, the zones in alternative C. The zones identified from the modeling outputs are described below. The consequences are described separately by alternative in the analysis that follows.

Overview of the Proposed Strategic Fire Management Zones

Strategic Fire Management Zones in Alternative A

The zones in alternative A shown in figure 13 were created for the existing forest plan during the 2004 Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004d) and were not created using a wildfire risk assessment.

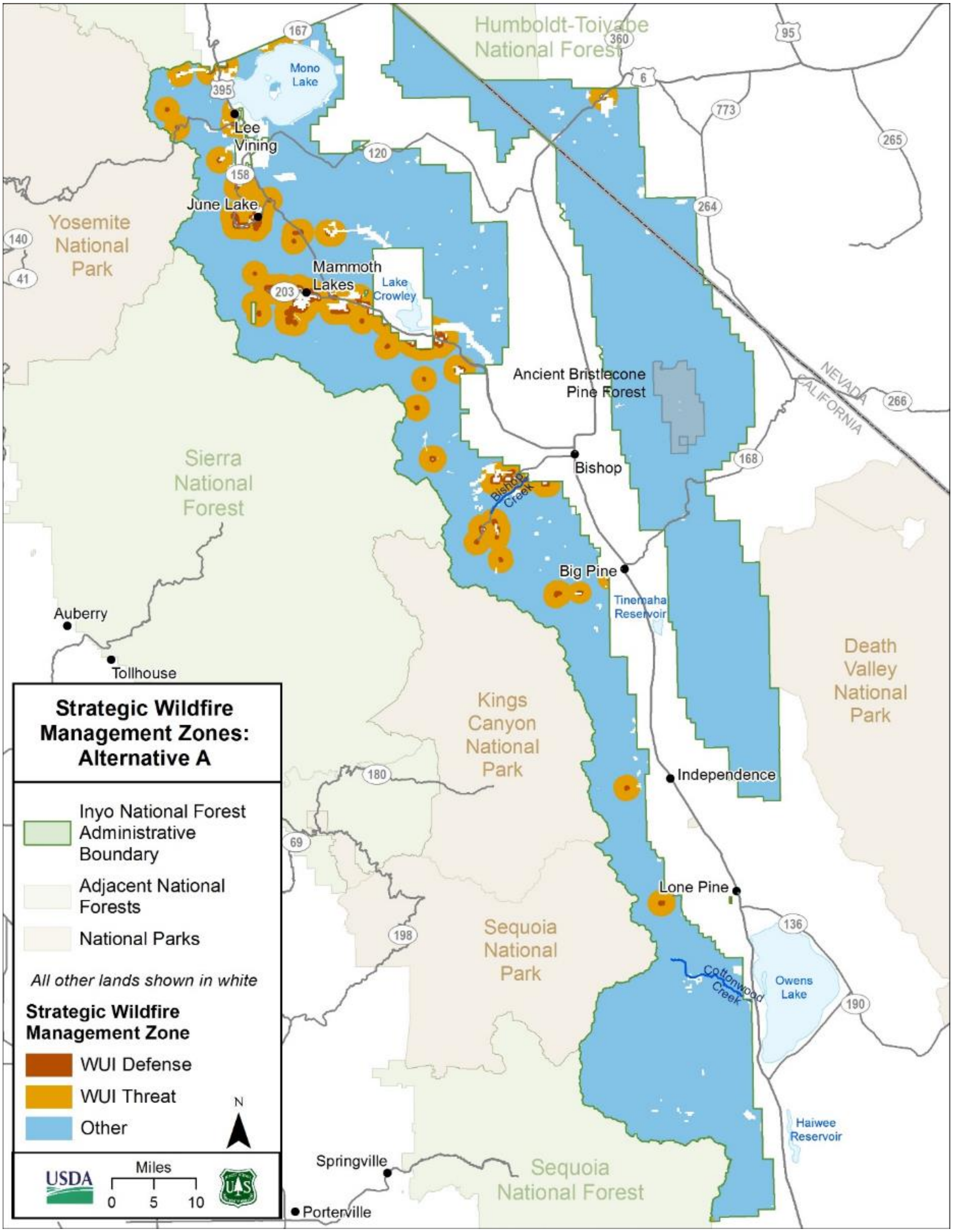

Figure 13. Map showing the location of the strategic fire management zones for alternative A

1. **Wildland-urban Intermix Defense Zone:** This zone identifies areas with a one-quarter-mile buffer from structures. Fire management direction within this zone focuses on hazardous fuel reduction treatment as the highest priority. Fuel reduction treatments (mostly mechanical) in this zone are the most intense to create defensible space to prevent the loss of life and property. Wildfires will continue to be managed using the appropriate suppression strategy.
2. **Wildland-urban Intermix Threat Zone:** This zone identifies areas with a buffer of 1.25 miles beyond the one-quarter-mile buffer from the wildland-urban intermix defense zone. Fire management direction within this zone focuses on hazardous fuel reduction treatment as the highest priority. Fuel reduction treatments in this zone are strategically located to interrupt wildfire spread and reduce fire intensity. Wildfires will continue to be managed using the appropriate suppression strategy.
3. **Other:** This zone identifies areas in the rest of the national forest outside the wildland-urban intermix defense and threat zones. This area encompasses other land allocations, but home range core areas, old forest emphasis areas, general forest, and wilderness allocations predominate. Fuel treatments in the general forest are designed to support treatments in the wildland-urban intermix threat zone, to protect sensitive habitats, and reintroduce fire into fire-dependent ecosystems. Wilderness is managed to maintain predominantly natural and natural-appearing environments and mechanical vegetation treatments are not allowed. Prescribed fire can be used to reduce the risk and consequences of wildfire burning within wilderness, or prevent wildfire escaping from wilderness to an acceptable level. Lightning-caused wildfires may be managed to meet resource objectives when conditions allow and it can be done in a safe manner.

Strategic Fire Management Zones in Alternative B

The zones for alternatives B are management areas created from modeled outputs produced by the wildfire risk assessment. The proportion of area in each zone is shown in figure 18 along with a map in figure 14.

1. **Community Wildfire Protection Zone:** This zone identifies the areas where communities, community assets, and private land could be at a high risk of damage from wildfire. This zone assists with preparedness decisions, communication and outreach to high-risk communities, and prioritization of fuel treatments within and near communities. Although it may be limited, lightning-caused wildfires may be managed to meet resource objectives when conditions allow, and it can be done in a safe manner as identified within the current forest plans.
2. **General Wildfire Protection Zone:** This zone identifies areas with a moderate to high risk to communities and assets as well as natural resources. This zone assists in prioritizing fuel treatments and fire management activities where targeted ecological restoration and hazardous fuel reduction will be needed to contribute to the protection of communities. Although it may be limited, lightning-caused wildfires may be managed to meet resource objectives when conditions allow, and it can be done in a safe manner as identified within the current forest plans.

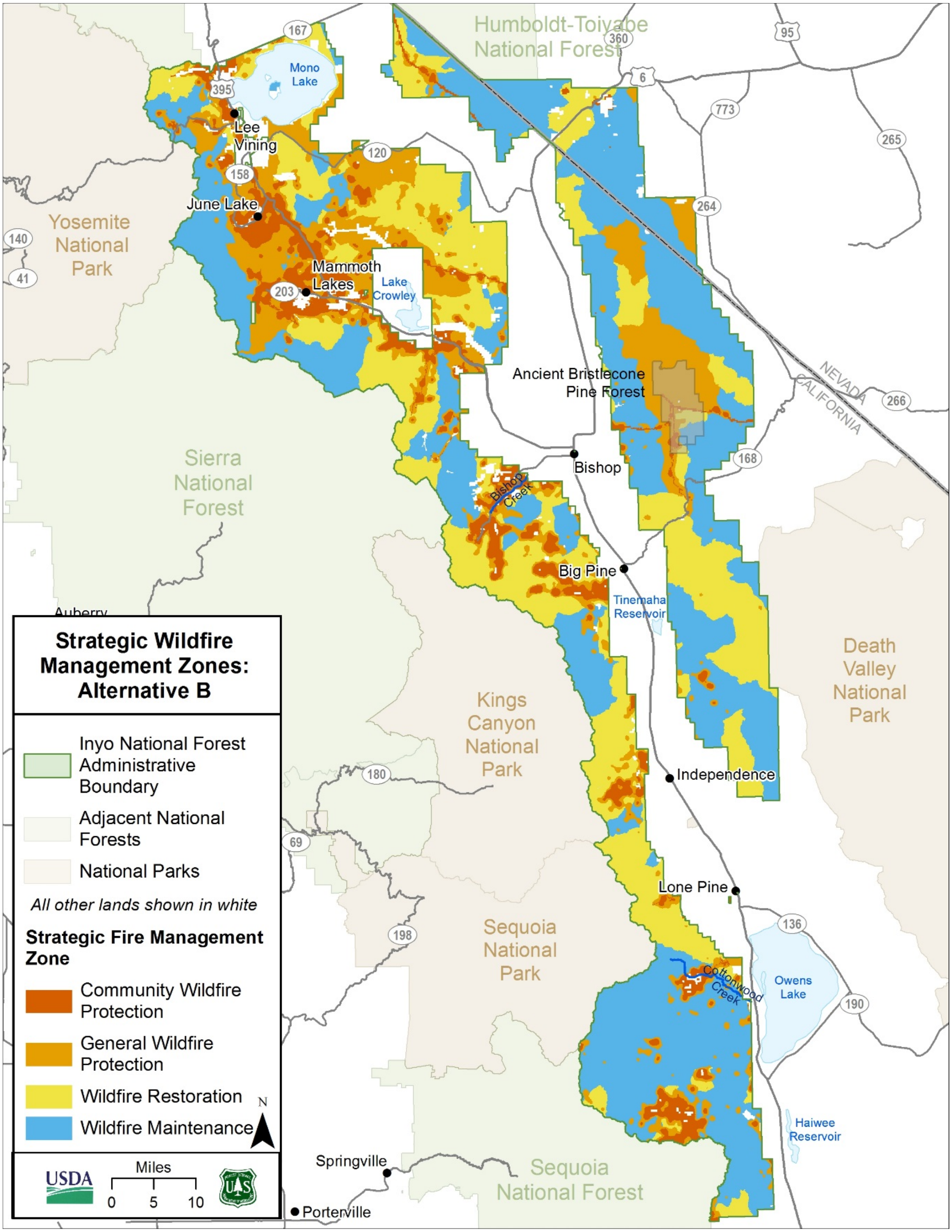

Figure 14. Map showing the location of the strategic fire management zones for alternative B

3. **Wildfire Restoration Zone:** This zone identifies the areas with a low to moderate risk, mostly to natural resources and some risk to assets. This zone assists with prioritization of fuel reduction treatments to create more opportunities under a wider range of conditions to manage wildfires to meet resource objectives and achieve forest plan desired conditions. The management of wildfires to meet resource objective is encouraged when conditions allow and when it can be done in a safe manner.

4. **Wildfire Maintenance Zone:** This zone identifies the areas with very low risk, mostly to natural resources and some risk to assets. Wildfires that occur in this zone will likely maintain or help achieve forest plan desired conditions. The management of wildfires to meet resource objective and applying prescribed fire treatments is encouraged when conditions allow and when it can be done in a safe manner.

Strategic Fire Management Zones in Alternatives B-modified and D

The zones for alternatives B-modified and D are management areas created from modeled outputs produced by the wildfire risk assessment. Modifications were made to correct errors to highly valued resources and assets and adjust potential wildland fire operational delineation units (PODs) when creating the zones (see chapter 2). The proportion of area in each zone is shown in figure 19 along with a map in figure 15.

1. **Community Wildfire Protection Zone:** This zone identifies the areas where communities, community assets, and private land could be at a high risk of damage from wildfire. This zone assists with preparedness decisions, communication and outreach to high-risk communities, and prioritization of fuel treatments within and near communities. Although it may be limited, lightning-caused wildfires may be managed to meet resource objectives when conditions allow, and it can be done in a safe manner as identified within the current forest plans.

2. **General Wildfire Protection Zone**: This zone identifies areas with a moderate to high risk to communities and assets as well as natural resources. This zone assists in prioritizing fuel treatments and fire management activities where targeted ecological restoration and hazardous fuel reduction will be needed to contribute to the protection of communities. Although it may be limited, lightning-caused wildfires may be managed to meet resource objectives when conditions allow, and it can be done in a safe manner as identified within the current forest plans.

3. **Wildfire Restoration Zone:** This zone identifies the areas with a low to moderate risk, mostly to natural resources and some risk to assets. This zone assists with prioritization of fuel reduction treatments to create more opportunities under a wider range of conditions to manage wildfires to meet resource objectives and achieve forest plan desired conditions. The management of wildfires to meet resource objective is encouraged when conditions allow and when it can be done in a safe manner.

4. **Wildfire Maintenance Zone:** This zone identifies the areas with very low risk, mostly to natural resources and some risk to assets. Wildfires that occur in this zone will likely maintain or help achieve forest plan desired conditions. The management of wildfires to meet resource objective and applying prescribed fire treatments is encouraged when conditions allow and when it can be done in a safe manner.

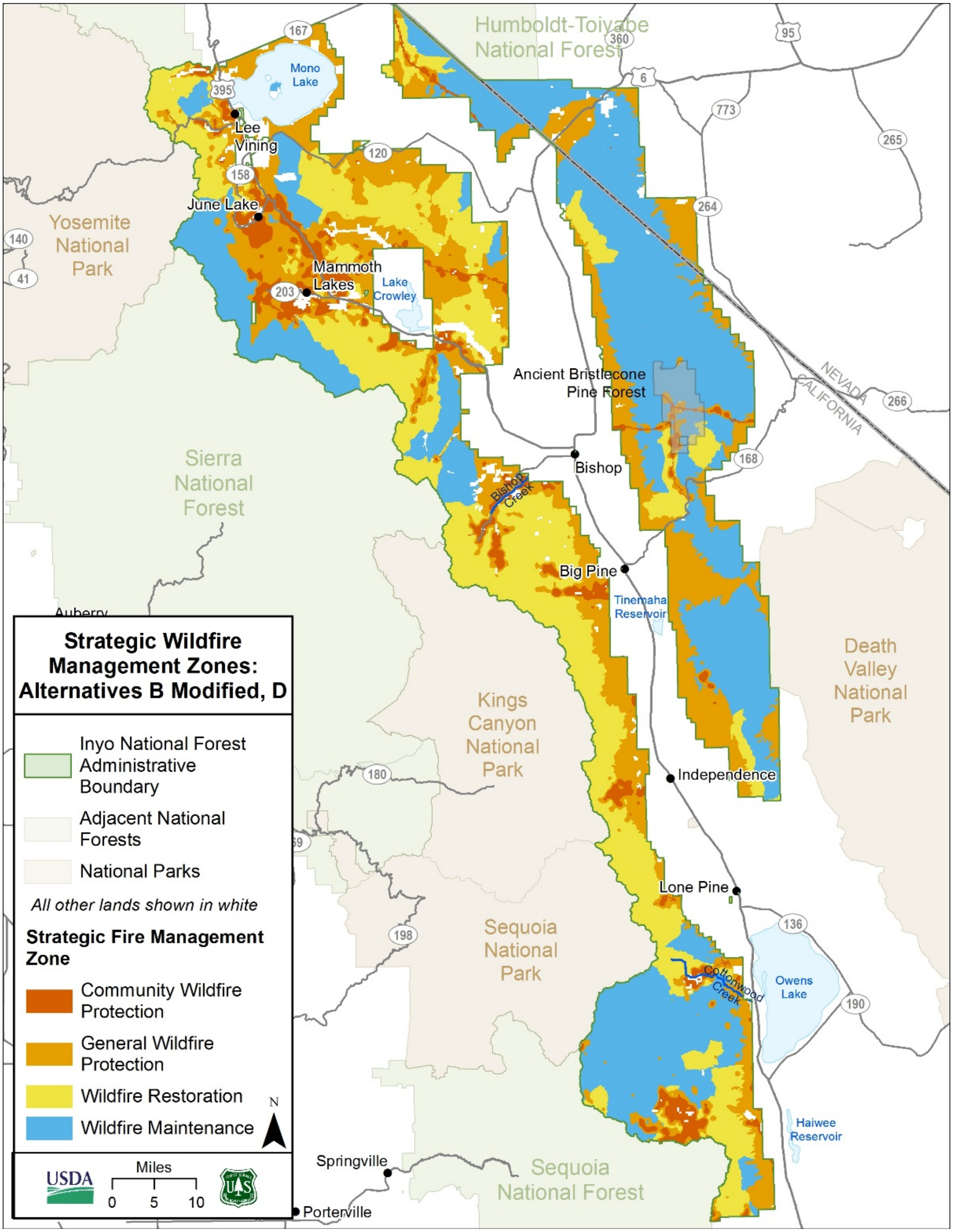

Figure 15. Map showing the location of the strategic fire management zones for alternatives B-modified and D

Strategic Fire Management Zones in Alternative C

The zones created for alternative C are management areas based on a combination of existing management areas and modeled outputs from the wildfire risk assessment (figure 16).

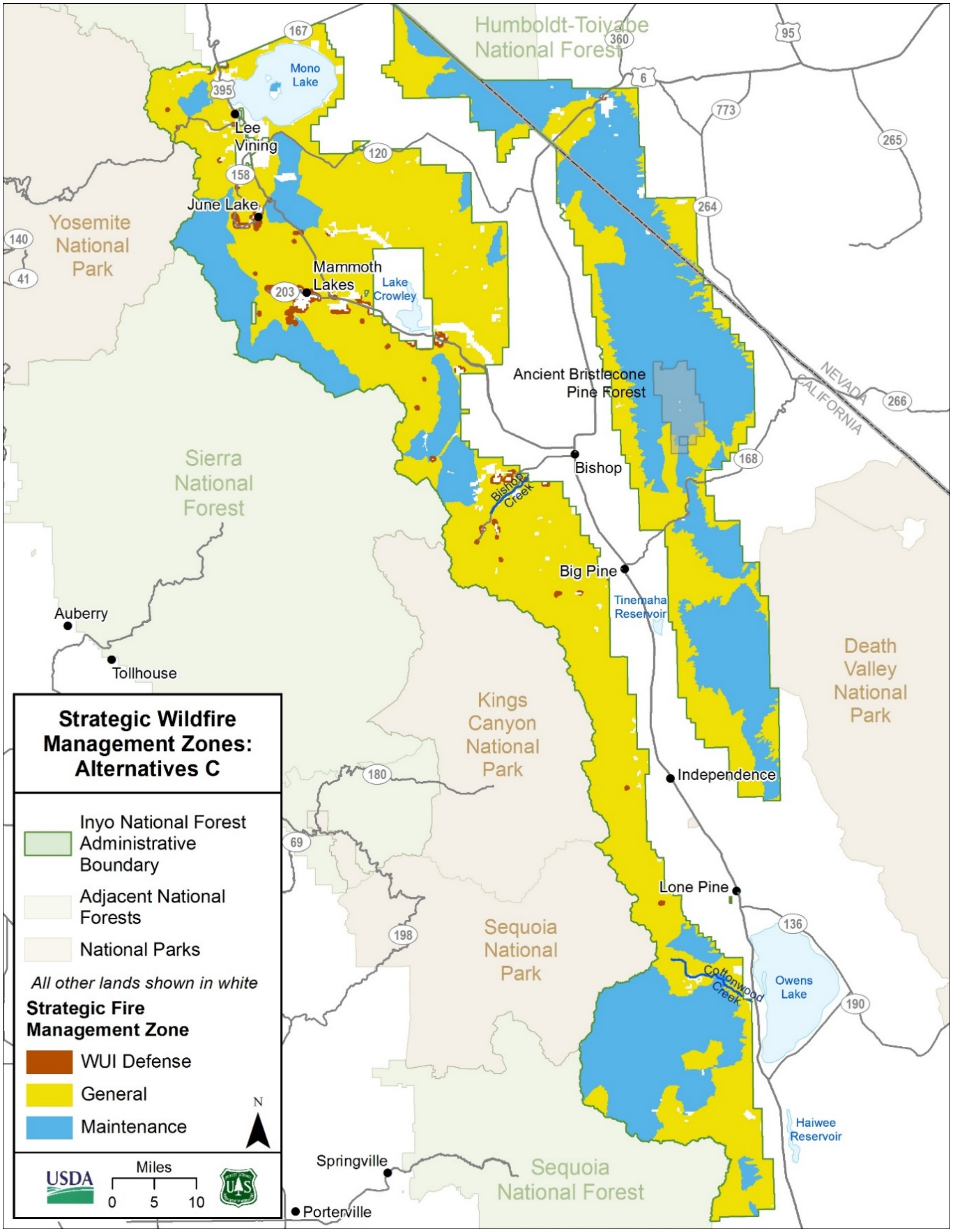

Figure 16. Map showing the location of the strategic fire management zones for alternative C

The distance-based wildland-urban intermix defense zone around communities would remain the same as in the existing plan. The maintenance zone is created using the same risk-based methodology used to create the wildfire maintenance zones as alternative B-modified and D. The general wildfire zone consists of the restoration zone, general wildfire protection zones, and portions of the community wildfire protection zone. Modifications were made to correct errors to highly valued resources and assets and adjust potential wildland fire operational delineation units (PODs) when creating the zones (see chapter 2).

1. **Wildland-urban Intermix Defense Zone:** This zone identifies areas created with a one-quarter-mile buffer from structures. This zone is the same as the wildland-urban intermix defense zone in alternative A.
2. **General Wildfire Zone:** This zone identifies a broad area, including the wildfire restoration zone, general wildfire protection zone, and portions of the community wildfire protection zone from alternatives B, alternative B-modified, and D. An increased emphasis on managing wildfire to meet resource objectives and increased use of prescribed fire in fire adapted ecosystems would occur in this zone.
3. **Wildfire Maintenance Zone:** This zone identifies areas with very low risk, mostly to natural resources and some risk to assets. Wildfires occurring in this zone will likely maintain or help achieve forest plan desired conditions. This zone was created with the same concept as the wildfire maintenance zone in alternatives B, B-modified, and D; however, the proportion of the forest area that it covers is slightly higher due to the way the zones were divided. Management of wildfires to meet resource objectives and applying prescribed fire treatments is encouraged in this zone when conditions allow and when it can be done in a safe manner.

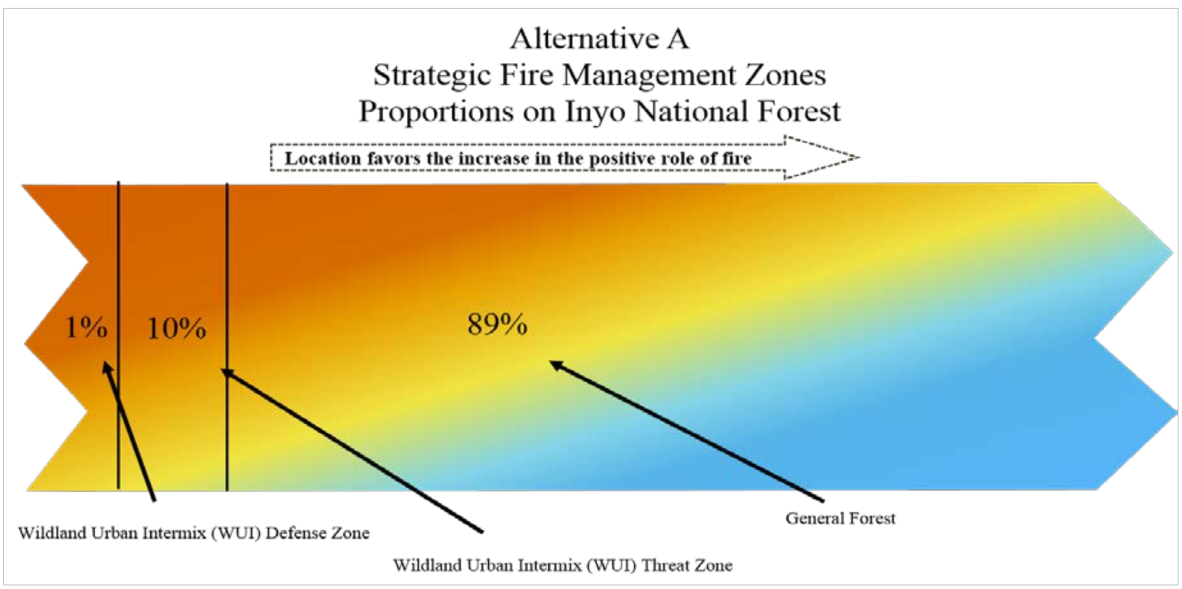

Figure 17. Proportion of the Inyo National Forest within each zone in alternative A

Consequences Specific to Alternative A

Under this alternative there are two fire management oriented zones and the rest of the general forest area referred to as “other” (see figure 13). The proportion of the total area of the Inyo National Forest within each zone are 1 percent in the wildland-urban intermix defense zone, 10 percent in the wildland-urban intermix threat zone and 89 percent in “other” as shown in figure 17.

These two wildland-urban intermix zones were created using proximity to communities as a proxy for fire risk, with the highest risk immediately adjacent to communities but recognizing fires that start more than 1.5 miles away from communities and outside of the wildland-urban intermix can still be a threat. These wildland-urban intermix zones are used primarily to prioritize fuel treatments on each national forest.

The focus of fire management in this alternative is to use mechanical treatments and prescribed fire to slow fire spread in the forest overall and provide defensible space in the wildland-urban intermix. Treating along key roads and ridges provides fire managers with opportunities to develop operational plans to conduct larger prescribed burns or to manage wildfires to meet resource objectives.

Under alternative A, the primary response to wildfire ignitions is to continue suppressing most lightning fires, which will continue to move areas away from the natural range. Fuel reduction treatments (prescribed burning and mechanical treatment) would remain the same as under current direction.

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: Alternative A was developed with an emphasis on reducing fire threats to communities based upon a concept of two distance-based zones in the wildland-urban intermix where fuel reductions are concentrated. Alternative A does not assess the potential benefits or damages to resources that would be expected from wildfires. The wildfire risk assessment validates that the existing wildland-urban intermix defense and threat zones reasonably capture where potential damages might occur in relation to where people live as shown by the amount of red and orange areas in figure 13 in those zones. However, the two wildland-urban intermix zones do not capture potential damages to infrastructure outside these areas or to natural resources as shown in the amount of red and orange in the “other” portion of the forest. In addition, benefits to natural resources from wildfires shown in the blue areas in figure 13 are not captured, so areas where wildfires could contribute to ecosystem restoration and maintenance of ecosystem functions are not identified.

In alternative A, it is more difficult for forest and fire managers to know where the potential damages and benefits are located when deciding on a fire management strategy when a fire ignition occurs. Under this alternative, these decisions are typically supported by analysis and information about potential wildfire risks and benefits gathered on-the-fly after the wildfire starts. This can be challenging when there are multiple fires occurring in the area, across states, or across the nation. In these situations, fire resources are scarce and precautionary decisions to suppress fires are often made by default. With current fire management strategies that lack upfront identification of potential risks and benefits and associated plan components that identify resource objectives, there would be a continued emphasis on suppressing wildfires.

Facilitating Wildland Fire Management: The primary emphasis in alternative A is to reduce the threat of wildfire to communities in the wildland-urban intermix. The strategies and priorities were designed to reduce fuels near communities and employ fuel reduction treatments in other areas of the forest so fires would burn into them and slow down and lessen their intensity to aid in suppression. The most flexibility to design effective fuel reduction treatments occurs in the wildland-urban intermix defense zone, closest to communities. Outside of the wildland-urban intermix defense zone, additional standards and guidelines apply to minimize or mitigate concerns for the effects of fuel reduction treatments on wildlife habitat. Some of those standards and guidelines are reduced or waived in the wildland-urban intermix threat zone to recognize the need for more effective treatments to reduce the potential for fires to burn from the threat zone into the defense zone and threaten communities. However, designing implementable and effective fuel reduction projects that comply with the standards and guidelines has been difficult in some areas, resulting in small, disconnected treatment units, or treated areas with residual fuels and vegetation that are not very effective at slowing fires down or that make prescribed burning more complex.

Most fuel reduction treatments are designed as mechanical thinning or mechanical manipulation of fuels followed by prescribed burning of treated units or burning of piles of fuels. In many cases, thinning has occurred but restoring fire through prescribed burning has yet to occur resulting in a backlog of areas ready for prescribed burning. The opportunity to apply prescribed burning over large landscapes is limited given the pattern of heavy fuels and interspersed areas where fuel reduction treatments have occurred.

The ability to manage wildfires to meet resource objectives is allowed, but it is rarely done. Previous plan direction does not emphasize additional fuel reduction treatments in key locations such as along ridges and key roads that can serve as anchor points for larger landscape prescribed burning or serve as tactical locations to manage wildfires to meet resource objectives. The current pattern of small and disconnected fuel reduction treatments under alternative A would remain at the same low pace and scale of treatment due to constraints for other resources; this is reducing the potential to restore and maintain landscapes to a level where they are sustainable, resilient, and can recover from disturbance.

Support Fire-adapted Communities

Managing Uncertainty: Under alternative A, the wildfire risk to communities and values are defined by the distance-based wildland-urban intermix defense and wildland-urban intermix threat zones, which were not created using a risk assessment. Although management activities in these zones are focused on protecting life and property, without a risk assessment management decisions in the general forest are likely to be less effective because managers don’t fully understand how risks are distributed across the landscape spatially and which highly valued resources and assets face the greatest loss or benefit. Important factors such as the type and distribution of fuels, terrain, winds, historic fire ignition locations, and the combinations of these factors are recognized as contributing to fire risk in the wildland-urban intermix, but they were not modeled to evaluate potential risk to communities in the wildland-urban intermix zones. Continued coordination with local partners and communities for protection and prevention in high wildfire risk areas exists to enhance the effectiveness of initial fire response.

Facilitating Wildland Fire Management: Although fuel reduction treatments are limited in alternative A, fire managers would continue to work with communities to be more fire adapted through collaborative efforts, supporting community wildfire protection plans, and conducting fuel reduction treatments in the wildland-urban intermix defense and threat zones. A priority is placed on fuel reduction in the two wildland-urban intermix zones. Alternative A does not account for the likelihood of fires to spread from adjacent areas in the “other” portions of the national forest that contribute to the risk to communities or infrastructure. Managing wildfires to meet resource objectives is a decision option, although it is rarely used near fire-adapted communities due to public concerns and the challenge of managing risks.

Improve Safe and Effective Fire Response

Managing Uncertainty: Under alternative A, risks have not been spatially identified outside the wildland-urban intermix defense and wildland-urban intermix threat zones. Without assessing risk upfront, pre-planning actions such as fuel reduction treatments and fire prevention actions would not be focused or prioritized on high risk locations. Wildfire response would continue to favor the current response of actively suppressing most fires. This would continue to make it difficult for fire managers to make on-the-fly decisions that consider the safety of fire responders and costs of the fire commensurate with values at risk because these risks to values are not evaluated upfront.

Facilitating Wildland Fire Management: The two wildland-urban intermix zones in alternative A do not provide the support for improving wildfire response to large, unwanted wildfires that could threaten communities, or identify where the potential damages and benefits are located to enhance wildfire response. The limited fuel reduction treatments are focused on slowing fire spread and reducing fuels in more easily treatable areas near roads and on flatter ground. The original intent to treat in a more geometric pattern so that wildfires would run into these areas like speedbumps has proven difficult to implement on the ground due to prescriptive and restrictive standards and guidelines that limit the type of treatment and the effectiveness of reducing fuels. Communities would continue to experience the risk of high-intensity fires that threaten structures and homes from fires that burn on national forest and move toward communities. Although the choice to manage wildfires to meet resource objectives exists, it is not the current management choice in most situations.

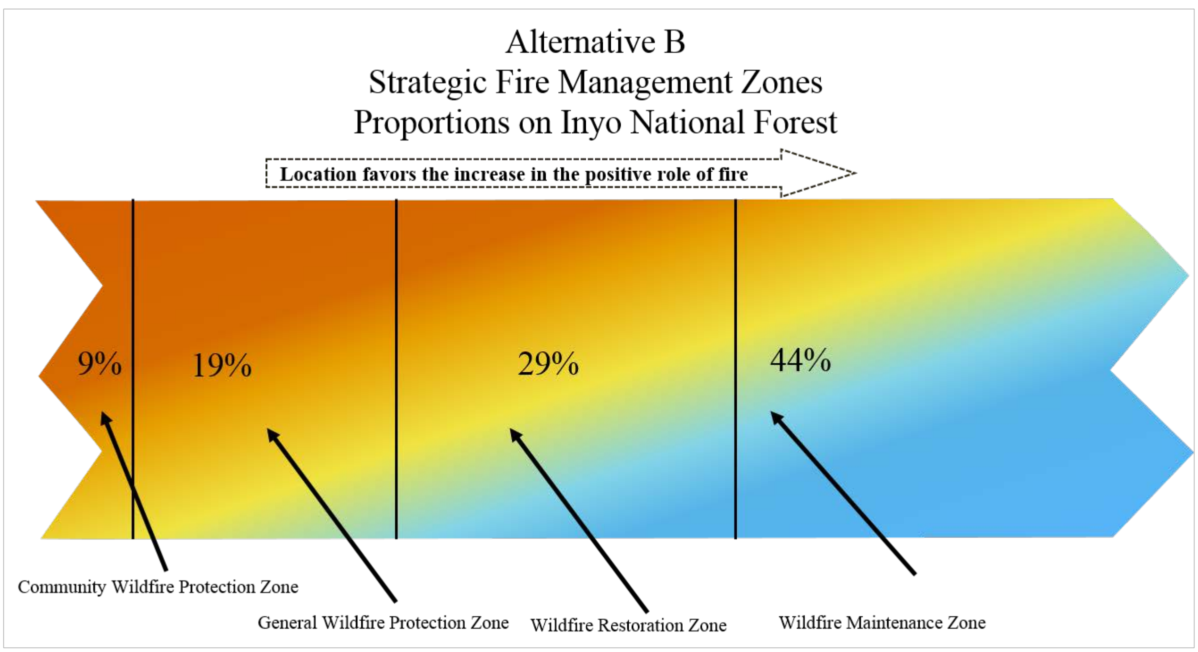

Figure 18. Proportion of the Inyo National Forest within each zone in alternatives B

Consequences Specific to Alternative B

Under this alternative there are four risk-based strategic fire management zones (figure 14).The proportion of the total area of the Inyo National Forest within each zone is 9 percent in the community wildfire protection zone, 19 percent in the general wildfire protection zone, 29 percent in the wildfire restoration zone and 44 percent in the wildfire maintenance zone (figure 18).

In alternative B, fuel reduction treatments are more extensive than alternative A to improve vegetation desired conditions and to make more areas suitable for managing fires to meet resource objectives. Managing wildfires to meet resource objectives is highly encouraged in the maintenance and restoration zones and somewhat limited in the protection and general zones.

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: Under alternative B, a full spectrum of fire management strategies ranging from full suppression (where fires are extinguished) to confine and contain, and monitoring (where fires can be managed to meet resource objectives) are available across all the zones. Allowing the natural role of fire to occur under conditions that are conducive to meeting resource objectives when it can be done in a safe manner would provide for ecological restoration and improved resilience within any of the zones. Having the flexibility to manage wildfire along the full range of the continuum can be useful if decisionmakers have the needed information to decide to use that flexibility. In this alternative, the strategic fire management zones were designed with the risk assessment that reduces uncertainty to fire management decisionmakers. The zones categorize the locations of where the values of highly valued resources and assets change positively or negatively for both assets and natural resources. These zones capture where benefits and damages are likely to happen under a wide range of fire conditions because the zones were developed using a modeled risk assessment. Important strategic locations are identified in relation to potential damages and benefits, most of which are along zone boundaries. The condition a fire burns under ultimately dictates the outcome of the fire but these zones aid in defining the location of likely outcomes. Managing uncertainty should result in more wildfire being managed in a way that restores and maintains landscapes; however, it is expected that this would occur the most often in the wildfire restoration and wildfire maintenance zones because these zones identify the areas with the lowest risk to highly valued resources and assets.

Facilitating Wildland Fire Management: Wildfire management under alternative B provides an increased opportunity to manage larger wildfires due to the increased amounts of treatments that reduce fuel loading in strategic locations. In alternative B, there would be more opportunity for fuel reduction projects and wildfires managed to meet resource objectives. Treatments would be prioritized in strategic locations (roads, ridgetops, and other natural and manmade features) designed to treat primarily the dry forest patches to restore fuels toward the natural range of variation. These treatments would serve as anchor points for larger prescribed burns and they create areas of low fuel that can be used to manage future wildfires. All of these restoration activities would reduce potential smoke emissions from large, undesirable wildfires.

Support Fire-adapted Communities

Managing Uncertainty: The community and general wildfire protection zones capture a substantial portion of the high fire risk to communities and assets as shown by the large portion of red and orange in figure 18. Increased fuel reduction treatments in alternative B would assist in creating more fire-adapted communities with improved certainty of resource and asset locations in the community and general wildfire protection zones. The identification of fire risk would aid in coordination with State and local fire agencies.

Facilitating Wildland Fire Management: More fuel reduction treatments occur in alternative B than in alternative A. Fire managers would continue to work with communities to help them become more fire adapted through collaborative efforts, such as supporting community wildfire protection plans and prioritizing fuel reduction treatments in the community and general wildfire protection zones. Managers would continue to coordinate with local partners and communities for protection and prevention in the high wildfire risk areas to enhance the effectiveness of initial response to fires. Although the use of wildfire to meet resource objectives would likely be limited initially in the wildfire protection zones, more fuel reductions treatment would lower the risk over time and increase the potential to reduce fire suppression costs by managing at least portions of wildfires to meet resource objectives.

Improve Safe and Effective Fire Response

Managing Uncertainty: In alternative B, risks are better identified than in alternative A by the creation of the four strategic fire management zones based upon the wildfire risk assessment. The zones reduce uncertainty by categorizing risk and allow for fires to be managed on a continuum between meeting protection objectives and resource objectives within these zones, while using risk-based responses. Categorizing the potential benefits along with the residual risks to resources reduces uncertainty in the wildfire restoration and maintenance zone as shown by the gradation of red to blue in those two zones as shown in figure 18.

Facilitating Wildland Fire Management: In alternative B, treatments would be designed along strategic roads, ridgetops, and other natural and manmade features that would create more opportunities to conduct larger prescribed burns and provide tactical locations to manage future wildfires. This alternative allows for wildfires to be managed to meet resource objectives as areas on the landscape (zones) shift toward the wildfire maintenance zones. The additional recommended wilderness areas in the community and protection zones could limit use of mechanized equipment during wildfire response and limit fuel reduction treatments, but use of prescribed fire could occur under some circumstances when it is for restoring fire toward the natural range of variation and to meet wilderness desired conditions. In the community wildfire protection zone, community buffers are identified in close proximity to structures where fuel conditions, large logs, and snags are treated to allow for safer conditions for firefighters and public safety (Ewell et al. 2012, Agee and Skinner 2005).

Consequences Specific to Alternative B-modified

Alternative B-modified uses the same strategic fire management zones as described for alternatives B and D (figure 15). The proportion of the total area of the Inyo National Forest within each zone is 6 percent in the community wildfire protection zone, 28 percent in the general wildfire protection zone, 27 percent in the wildfire restoration zone and 39 percent in the wildfire maintenance zone (figure 19).

The proportions are slightly different than the zones in Alternative B because the zones in alternatives B-modified and D were created using modifications to the data used in the risk assessment (see chapter 2, “Revision Topic 1: Wildland Fire Management,” “Strategic Fire Management Zones” for specific modifications).

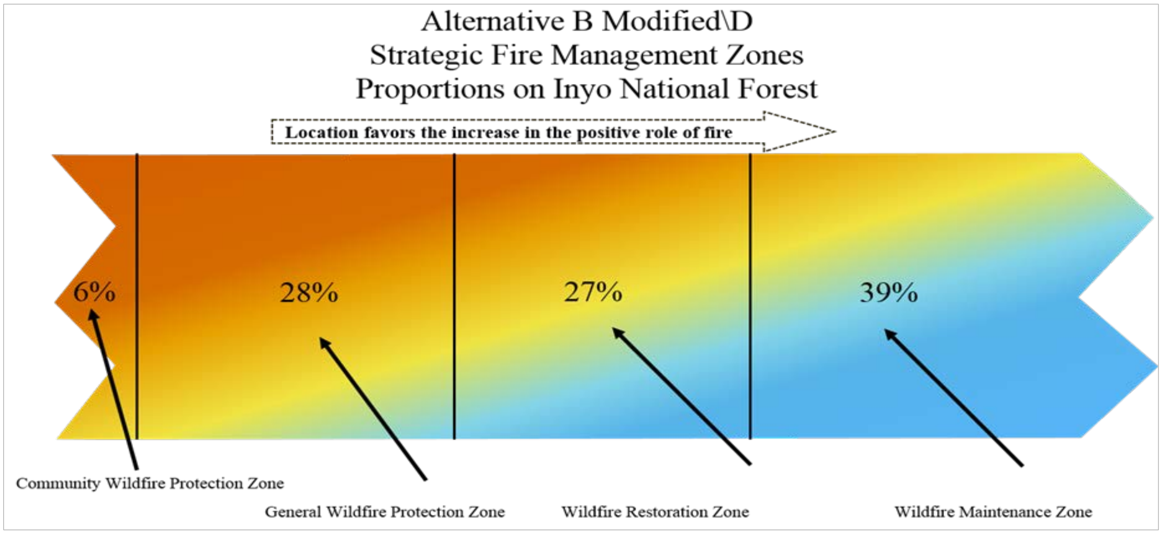

Figure 19. Proportion of the Inyo National Forest within each zone in Alternatives B-modified and D

Consequences Specific to Alternative C

In alternative C, mechanical fuel reduction treatments are focused around structures and limited in other areas in alternative C. Managing wildfire to meet resource objectives is limited in the wildland-urban intermix defense zone (1 percent) and highly encouraged in the general wildfire and wildfire maintenance zones (58 percent and 41 percent, respectively; figure 20).

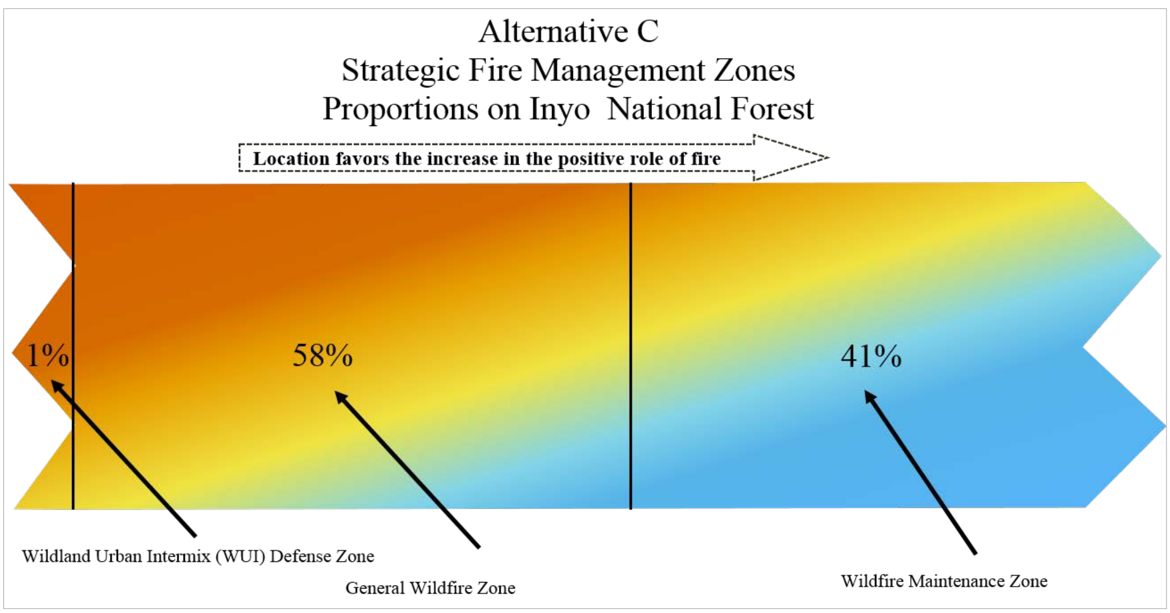

Figure 20. Proportion of the Inyo National Forest within each zone in alternative C

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: Under alternative C, a full spectrum of fire management strategies ranging from full suppression (where fires are extinguished) to confine/contain and monitoring (where fires can be managed to meet resource objectives) are available across all the zones.

Similar to alternative A, fires would be managed to meet resource objectives when conditions allow and it is safe to do so; however, with much uncertainty in the general wildfire zone. The wildfire maintenance zone was created using the risk assessment and generally occurs in the higher elevations and wilderness areas. The wildland-urban intermix defense zone was defined by proximity to communities and is primarily at the lower elevations along the national forest boundary, but it also surrounds smaller communities and developments within the national forest. This leaves a large area between these two zones, which became the general wildfire zone with a wide range of highly valued resources and assets potentially changing value from high damage shown in the red and orange in the upper left, to low benefit shown in blue and green in the bottom right. This wide range in risk in the general wildfire zone provides decision makers little information to aid in choosing an appropriate management strategy for a wildfire.

Facilitating Wildland Fire Management: Mechanical fuel reduction treatments in this alternative would be more restricted than in alternative A, but strategically placed as in alternative B. The costs of removing only small material would limit the amount of area that can be accomplished due to the need to use appropriated funding where projects cannot offset costs with timber harvest and stewardship funding. This would leave more fuels to be removed by prescribed burning, which may require multiple prescribed burns over time to effectively reduce fuels. Prescribed burning would be encouraged and would likely initially focus on burning areas previously treated mechanically and expanding treated and burned areas to larger landscapes. Prescribed burns may be more complex compared to if fuels were reduced mechanically; this would require additional fire resources to complete the burn and more careful planning for weather and fuel conditions to safely meet burn objectives. When conditions allow and it is safe to do so, wildfires would be managed to meet resource objectives under this alternative, but this is mostly limited to the wildlife maintenance zone due to the more limited areas of effective fuel reduction treatment in the other zones.

Support Fire-adapted Communities

Managing Uncertainty: The wildland-urban intermix defense zone captures much of the risk closest to communities but does not account for the likelihood of fires to spread from high risk areas in the adjacent general wildfire zone to the wildland-urban intermix defense zone, which would threaten communities or infrastructure (as shown by the large area of red and orange in the general wildfire zone in figure 20). In this alternative, fuel reduction and preparedness in the communities are relied upon more to manage risk on the lands closest to the structures.

Facilitating Wildland Fire Management: In alternative C, continued coordination with local partners and communities for protection and prevention in high wildfire risk areas would enhance the effectiveness of initial response. Mechanical fuel reduction treatments would be more limited in alternative C than in alternatives B and D as limitations on mechanical treatments to provide for habitat for the California spotted owl apply even within the wildland-urban intermix defense zone. However, fire managers would continue to assist communities in being more fire adapted through collaborative efforts such as community wildfire protection plans and an increased focus on fuel reduction treatments where possible in the wildland-urban intermix defense zone. There is the least amount of mechanical treatment and it is limited to primarily small-diameter tree removal. This would make it more costly and take longer to conduct some prescribed burns where fuels are heavier and multiple prescribed burns may be needed to achieve effective fuel reduction. Prescribed burning is encouraged in lieu of mechanically removing medium and larger trees but where the costs of prescribed burning is higher due to heavier fuels and where it takes multiple prescribed burns to reduce fuels, there would be fewer acres with effective fuel reduction compared to the other alternatives. There is more uncertainty in completing prescribed burning as the primary method to reduce fuels because of the increased complexity to plan and implement prescribed burns in areas with high fuels. The management opportunity to manage wildfires to meet resource objectives exists under this alternative in all zones but is not likely to be used in the wildland-urban intermix defense zone or general wildfire zone.

Improve Safe and Effective Fire Response

Managing Uncertainty: Under alternative C, risks have been identified outside of the wildland-urban intermix defense zone. Similar to alternatives B, B-modified, and D, the wildfire maintenance zone reduces the uncertainties of where potential resource benefits can be obtained by managing wildfire to meet resource objectives in the higher elevation areas. However, similar to alternative A, there is a large portion of the national forest with little improvement in reducing the uncertainty for potential risks and benefits to highly valued resources and assets as shown by the large area with red and orange in the general wildfire zone shown in figure 20. This large uncertainty in the general wildfire zone makes it difficult to make fire management decisions that consider safety to firefighters and the public in relation to risks to highly valued resources and assets.

Facilitating Wildland Fire Management: In this alternative, there would be the fewest areas where fuels are reduced mechanically prior to prescribed burning of all alternatives. Fuel reduction treatments would primarily be with mechanical removal of small-diameter trees, mostly in the wildland-urban intermix defense zone. Some strategic treatments along key roads and ridges may occur, which may facilitate some large prescribed burning but with heavier initial fuels. However, it may make it more difficult to conduct prescribed burns due to an increased complexity of the burns and more limited timing when weather and fuels conditions would allow prescribed burns to be safely conducted and meet burn objectives. In areas where prescribed burning has occurred, there would be greater opportunities to manage future wildfires. Where fuels are heavier (higher densities of trees, large snags, and high surface fuel loading) or fuel reduction treatments are less effective, the primary response to wildfire ignitions would likely continue to favor suppression. The opportunity to manage wildfires to meet resource objectives exists under this alternative in all strategic fire management zones; however, with the uncertainty of risks to structures and assets, the possibility of this management response may be limited except in the wildfire maintenance zone.

Consequences Specific to Alternative D

Alternative D uses the same strategic fire management zones as described for alternatives B and B-modified above. Fuel reduction treatments would be applied in all strategic fire management zones dependent on vegetation conditions, with fewer funding and resource limitations than any other alternative. Mechanical treatments are slightly higher than all other alternatives. Like alternatives B and B-modified, managing wildfire to meet resource objectives is highly encouraged in the wildfire maintenance and restoration zones and somewhat limited in the community wildfire protection and general wildfire protection zones.

Restore and Maintain Landscapes Through the Use of Wildfire

Managing Uncertainty: In alternative D, managing uncertainty would be the same as described previously for alternatives B and B-modified.

Facilitating Wildland Fire Management: The same amount of strategic treatments along ridgetops, roads, and other natural and manmade features to support large landscape prescribed burns or as an opportunity to manage wildfires to meet resource objectives are allowed in alternative D as in alternatives B and B-modified. As with alternatives B and B-modified, important strategic locations are identified in relation to potential damages or benefits, most of which are along the boundaries between zones. These fuel reduction treatments would result in areas of reduced fuels and restoring vegetation toward its natural fire regime, which has the greatest benefit for restoring fire in the wildfire restoration and maintenance zones. Under alternative D, there would be more opportunity than alternative C for fuel reduction projects, which increases the potential for wildfires managed to meet resource objectives in all zones. There would be more potential to manage wildfires to meet resource objectives if there are more areas with fuel reduction and more strategic areas that can be used to control or contain fires. All of these restoration activities would reduce fuels and potential smoke emissions compared to large, undesirable wildfires.

Support Fire-adapted Communities

Managing Uncertainty: In alternative D, there would be more opportunity for coordination with local partners and communities for fire protection and prevention in high wildfire risk areas, which would enhance the effectiveness of initial fire response to the extent there is more collaborative fuel reduction projects in the community and general protection zones.

Facilitating Wildland Fire Management: There would be more fuel reduction treatment opportunities in alternative D than in all alternatives. Fire managers would continue to assist communities to become more fire adapted through continued collaborative efforts such as community wildfire protection plans and fuel reduction treatments. An increase in the amount of fuel reduction under this alternative includes more mechanical treatment and the same amount of prescribed burning as in alternatives B and B-modified. Fuel reduction in the wildfire restoration zone would further reduce the risk of large high-intensity wildfires starting further away on the national forest that may threaten communities.

Improve Safe and Effective Fire Response

Managing Uncertainty: In alternative D, risks are better identified than in alternatives A and C by the creation of the four strategic fire management zones. Fires are managed on a continuum between meeting protection objectives and resource objectives within these zones, while using risk-based responses. This alternative would reduce fuels on more of the landscape, which would reduce risks over time and should tend to shift areas toward less risk in future risk assessments.

Facilitating Wildland Fire Management: Alternative D has the highest possibility of generating revenue from treatments with timber harvest that can be invested in reducing fuels on more areas. This would allow for strategic treatments, mostly along roads, ridgetops, and other natural and manmade features to support large landscape prescribed burns or as an opportunity to manage wildfires to meet resource objectives. These applications would allow areas on the landscape to shift toward the wildfire restoration and wildfire maintenance zones as more areas with vegetation density move toward the natural range of variation, allowing fire to burn at lower intensity overall and with more variable patches of low, moderate, and high severity. This would give fire managers more options to provide for the safety of firefighters and the public while managing costs of fire suppression and risks and benefits to highly valued resources and assets.

Cumulative Effects

There are cumulative effects from the management of wildland fire by adjacent landowners. These include the National Park Service, managing Sequoia, Kings Canyon and Yosemite National Parks, the Bureau of Land Management, and State fire agencies. There are also large areas of private land adjacent to and within the plan area. The Park Service emphasizes fire restoration and has cooperated with the Forest Service numerous times on management of wildfires to meet resource objectives in the southern Sierra Nevada (Meyer 2015a). Under all alternatives, fire management is coordinated with neighboring units as agencies work together across jurisdictions and boundaries to manage fires.

The cumulative effect has been that on adjacent National Park Service and Sequoia National Forest lands there is a high level of restoration that has been accomplished in the last 15 years, greatly reducing the probability of large, high-intensity fires in this area. The Bureau of Land Management manages fires similarly to the Forest Service although with more of an emphasis on fire suppression. Consequently, there has been little wildfire managed to meet resource objectives on National Forest System lands near Bureau of Land Management lands.

Wildfire ignitions may increase in the Sierra Nevada with increased population growth (including increased human development in the wildland-urban intermix) and climate change. However, future projections in human-caused ignitions and lightning strike density are highly uncertain (especially the latter). This would have a cumulative effect of increasing the likelihood of large, high-intensity fires but to an unknown degree. Although some regions of the western United States may experience projected declines in wildfire extent and severity with climate change (due to reduced plant productivity in the later 21^{st} century), total burned area and fire severity in the Sierra Nevada are likely to increase or remain moderately high through the coming decades (Lenihan et al. 2008, Westerling et al. 2011, Parks et al. 2016).

Analytical Conclusions

Alternative A does not proactively analyze risk with a spatial risk assessment, which highly limits the restoration and maintenance of landscapes through managing wildfire to meet resource objectives, and the safe and effective fire responses due to the uncertainty of the location of assets and resource at risk. The lack of risk-informed fuel reduction treatments also limits the restoration and maintenance of landscapes through the use of wildfire, both with strategically located prescribed burning and wildfires managed to meet resource objectives. Alternative A relies heavily on a risk assessment after the fire has started and local fire manager knowledge to manage wildfire to meet resource objectives, but is not as reliable since it is more reactionary and depends primarily on experienced fire managers knowledgeable of the local conditions.

The strategic management zones created by the wildfire risk analysis for alternatives B, B-modified, and D identify areas of risk more accurately than the wildland-urban intermix defense and threat zones in alternative A and the wildland-urban intermix defense and general wildfire zones in alternative C. By using the spatial wildfire risk assessment, alternatives B, B-modified, and D allow identifiable areas on the landscape where strategic fuels and vegetation treatment might be cost-effective in managing wildfire. These alternatives also identify where fire may play a beneficial role and can be managed to meet resource objectives rather than taking suppression actions.

Alternatives A and C do not account for the likelihood of fires to spread from adjacent areas, which could potentially contribute to the risk to communities or infrastructure. Outside of the wildland-urban intermix defense and threat zones in alternative A, there is little specific direction that encompasses a risk management-based approach to wildfires. In alternative C, a risk management-based approach is applied in the wildfire maintenance zone and partially to create the general wildfire zone, but there are fewer fuel reduction treatments planned along strategic fire management features (such as along ridgetops, roads, or other natural or man-made features) that facilitate safely conducting more cost-effective, larger prescribed fires or that provide more opportunities to manage wildfires to meet resource objectives. Forest and fire managers would continue to work with communities and stakeholders to support fire-adapted communities under all alternatives, having the most restrictions under alternatives A and C.

In alternatives B, B-modified, C (partially), and D, the risk assessment provides information that reduces uncertainties and allows forest and fire managers to have more latitude to proactively plan and restore the landscape by managing wildfire to meet resource objectives and using prescribed fire, partially due to the awareness of where the assets are located, thereby reducing risk. Alternative C emphasizes the use of prescribed fire and limits mechanical treatment to small-diameter trees. Alternatives B, B-modified, and D apply risk management the most explicitly and have the most amount of restoration that reduces risk and provides resource benefits. The zones in alternatives B, B-modified, and D provide the most efficient and effective way to prioritize fuel reduction treatments around communities and other values at risk and prioritize ecological restoration to increase the potential to safely manage wildfires to reduce landscape fuels and benefit resources. The increase in ecological restoration projects and the enhancement of strategic fire management features would provide the greatest likelihood of implementing large prescribed fires or managing wildfires to meet resource objectives. This provides a safer work environment for firefighters, lowers the likelihood for fire that escapes control, and allows a larger window of opportunity to manage wildfire.

The following graphs compare the results for location and source from the risk assessment for all the alternatives (figure 21 and figure 22). The location identifies where on the landscape fire ignitions result in negative versus positive outcomes. The source identifies where the fire was ignited to identify spatial patterns on the landscape.

Figure 21 shows the amount of potential damage and benefits to assets and resources at the location of where these potential changes occur, based on modeled outputs. The pie charts on the left represent the percentage of the forest that resides in the different strategic fire management zones. The bar charts on the right show the percentage of benefit or damage to highly valued resources and assets.

A graph with higher values on the damage side leads to managing for protection objectives while those with higher values on the benefit side would result in managing primarily for resource value objectives. It is also important to know what is possibly going to be affected; zones that have a large proportion of either resource or assets helps in the wildfire management decisions. Alternatives B, B-modified, and D categorize risk location and can aid in managing uncertainty. For these reasons, alternatives B, B-modified, and D are more effective, because the protection zones have a higher damage-to-benefit ratio while the maintenance zones have a higher benefit-to-damage ratio, leading to less uncertainty in management decisions.

The amount of potential damage and benefits to assets and resources at the source (where wildfires start) that cause these changes based on modeled outputs are shown in figure 22.

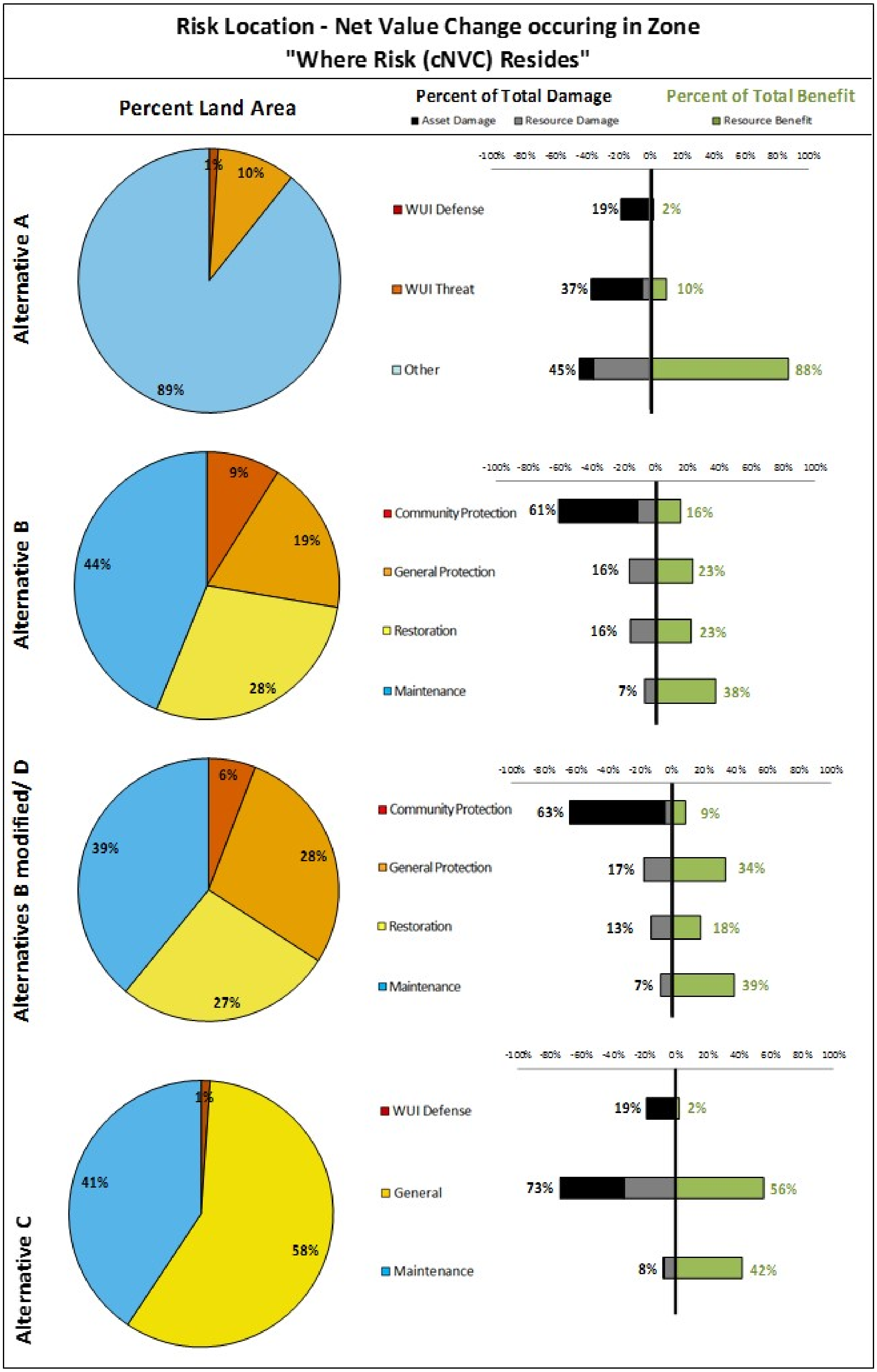

Figure 21. Risk location by alternative or comparison of the magnitude of net value change by strategic fire management zone

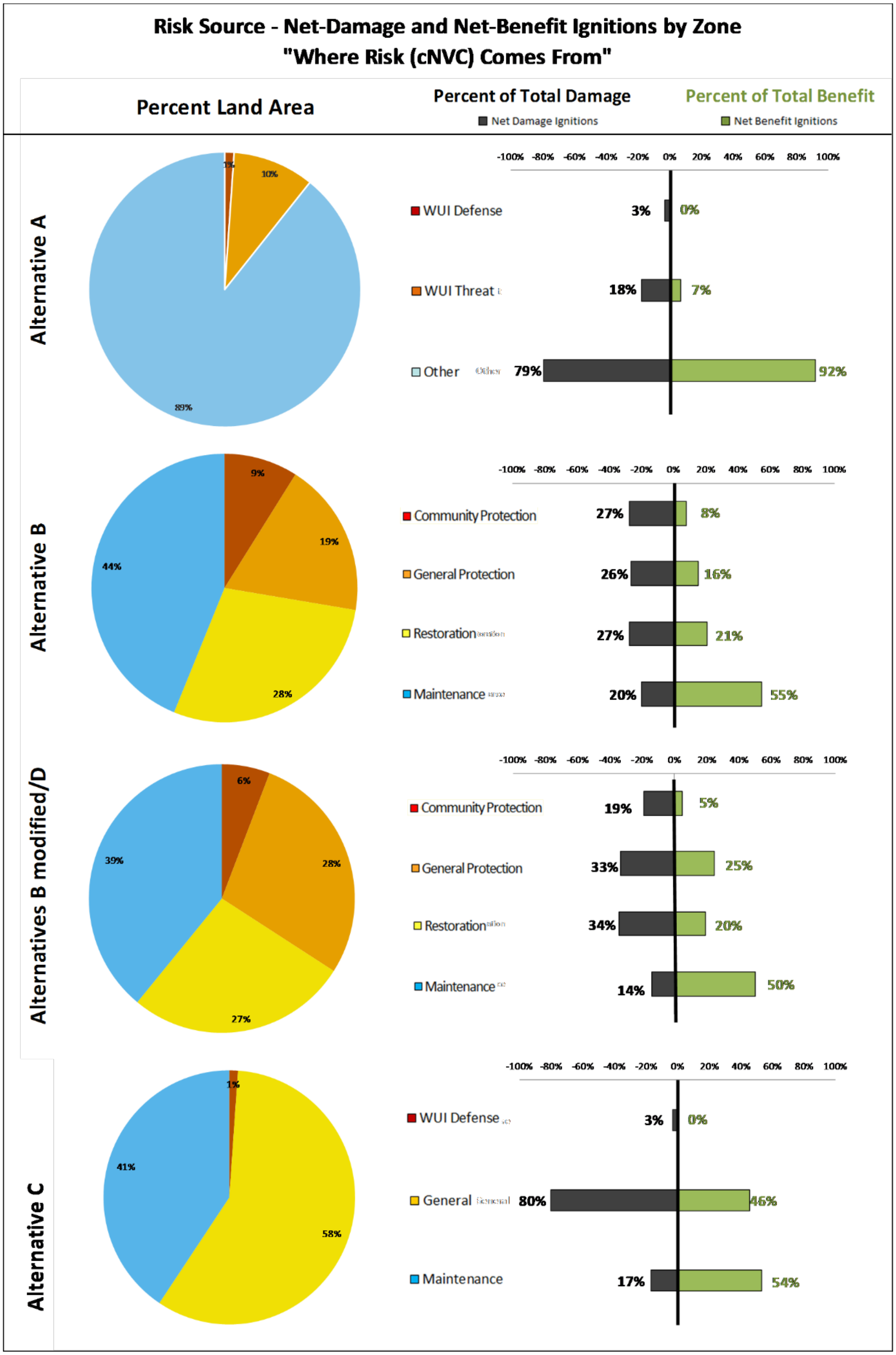

Figure 22. Risk source by alternative or comparison of the magnitude of net value change by strategic fire management zone

As before, the risk location of any strategic fire management zone with nearly equal potential for damage and benefits has a high level of uncertainty and adds little information for forest and fire managers in their wildfire management decisions. Also graphs that have a large proportion on one side or the other help manage uncertainty and aid in management decisions. A graph that has a larger proportion on the damage side leads to managing for protection objectives while those that have a larger proportion on the benefit side leads to primarily managing wildfire for resource value objectives. It is important to know what value is possibly going to be affected. Since these graphs capture changes from the source, most zones show both resource and assets affected because wildfires start in those zones and move into adjacent zones where resource and assets exist. However, alternatives B, B-modified, and D are more effective in categorizing risk and can aid in managing uncertainty because the majority of the asset damage is in the protection zones.

The five alternatives are ranked by the measures (managing uncertainty and facilitating fire management) for each indicator (table 11). All indicators were measured to rate how well each alternative addresses them. These measures were given a numerical rating based on how well they managed uncertainty and how well they addressed facilitating wildfire management. Note that the lower the number, the better the alternative in regard to meeting the fire management indicator. In this ranking indicators were equally weighted. Low: poorly represents actions that support the measures. Medium: may have some positive/negative with overall neutral outcome, High: greatly increases the ability to support the measures.

Table 11. Comparative ranking of alternatives by fire management indicators and measures

Alternative	Indicator	Managing Uncertainty	Facilitating Fire Management	Total
A	Restore and maintain landscapes	4	3	7
A	Fire-adapted communities	3	3	6
A	Wildfire response	3	3	6
B	Restore and maintain landscapes	2	2	4
B	Fire-adapted communities	2	2	4
B	Wildfire response	1	2	3
B-modified	Restore and maintain landscapes	2	2	4
B-modified	Fire-adapted communities	2	2	4
B-modified	Wildfire response	1	2	3
C	Restore and maintain landscapes	3	4	7
C	Fire-adapted communities	4	4	8
C	Wildfire response	4	4	8
D	Restore and maintain landscapes	2	1	3
D	Fire-adapted communities	2	1	3
D	Wildfire response	1	1	2

Wildfire Risk Management

The individual indicators shown in table 12 on page 144 can be summarized as an overall assessment of risk management for each alternative.

Consequences Specific to Alternative A

Managing Uncertainty: Fire management decisions in alternative A are not guided by risk-based strategic fire management zones. The two zones: wildland-urban intermix defense and wildland-urban intermix threat zones, and the general forest (which contains the areas outside of the other land allocations on the national forest) were generated for the forest plan (figure 13). Although these areas were not created using a wildfire risk assessment, due to the proximity to assets, potential damages to highly valued resources and assets in the wildland-urban intermix defense and threat zones are moderately captured. However, these two zones do not account for potential damages to infrastructure such as powerlines outside communities or the negative wildfire impacts to community ecosystem services such as water supplies and wildlife habitat. In regard to categorizing risk to aid management decisions, these two zones are not adequate, leaving the general forest with a wide range of risk ranging from a high potential for damage to a moderate potential for benefits. There are many uncertainties for location and source of risk under this alternative. Risk management is difficult when values at risk are not pre-identified.

Facilitating Wildland Fire Management: Fire management practices in alternative A would provide firefighter safety in all zones while providing asset protection (structures, powerlines, etc.). Implementing effective strategic fire management by managing wildfires to meet resource objectives and accomplishing fuel reduction treatments that improve safety during fire management practices would be limited to the current plan constraints. The level of safe and effective fire management to facilitate the appropriate management response to wildfire would remain the same. This would continue to allow the accumulation of fuels that contribute to large, unwanted wildfires that damage forests and wildlife habitat, negatively affect stream and watershed quality, reduce air quality with increased smoke, and threaten homes and communities in the wildland-urban intermix.

Consequences Specific to Alternative B

Managing Uncertainty: Alternative B is composed of four zones: community wildfire protection, general wildfire protection, wildfire restoration and wildfire maintenance (figure 14). These four zones were designed to categorize risk and reduce many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets. They facilitate fire management decisions by reducing the uncertainty of where and under what conditions wildfires are more likely to have positive outcomes and be suitable to consider for managing to meet resource objectives.

Facilitating Wildland Fire Management: Fire management practices in alternative B would provide firefighter safety in all zones while providing asset protection (such as structures and powerlines). An increase in implementing effective strategic fire management through fuel reduction treatments and managing wildfire to meet resource objectives would be more attainable. The risk-based strategic fire management zones would help prioritize fuel reduction in areas based upon the location and source of potential damages and benefits to highly valued resources and assets.

Consequences Specific to Alternative B-modified

Managing Uncertainty: Alternative B-modified is composed of the same four zones as alternatives B and D: community wildfire protection, general wildfire protection, wildfire restoration and wildfire maintenance (figure 15). Modifications were made to correct highly valued resources and asset errors and adjustments to potential wildland fire operational delineation units (PODs, chapter 2). These four zones were designed to categorize risk and reduce many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets. They facilitate fire management decisions by reducing the uncertainty of where and under what conditions wildfires are more likely to have positive outcomes and be suitable to consider for managing to meet resource objectives.

Facilitating Wildland Fire Management: Fire management practices in alternative B-modified would provide firefighter safety in all zones while providing asset protection (structures, powerlines, etc.) in the community wildfire protection and general wildfire protection zones. An increase in implementing effective strategic fire management through fuel reduction treatments and managing wildfire to meet resource objectives would be more attainable. The risk-based strategic fire management zones would help prioritize fuel reduction in areas based upon the location and source of potential damages and benefits to highly valued resources and assets.

Consequences Specific to Alternative C

Managing Uncertainty: Alternative C has three zones: the wildland-urban intermix defense zone, general wildfire zone, and wildfire maintenance zone (figure 16). The zones consist of a combination of existing plan direction and new zones created from the results of the wildland fire risk assessment. The distance-based wildland-urban intermix defense zone around communities would remain the same as in alternative A and does not account for potential damages to infrastructure and assets. The general wildfire zone consists of the restoration zone, general wildfire protection zones, and portions of the community wildfire protection zone. The general wildfire zone does not categorize risk well because it consists of a combination of risk-based zones where the risk ranges from a high potential of damages and moderate potential for benefits, thus resource objectives assigned to this zone cannot be safely used to make fire management decisions due to the wide range of uncertainty of risk. The maintenance zone was created using the same risk-based methodology used to create the wildfire maintenance zones as alternative B, B-modified and D, where there are lower risks. The zones in alternative C make it more difficult to manage fire compared to the other alternatives, due to the higher uncertainty of where risk resides combined with less fuel reduction treatments that primarily rely on prescribed fire and much less mechanical thinning of fuels.

Facilitating Wildland Fire Management: Fire management practices in alternative C would provide firefighter safety in all zones while providing asset protection (structures, powerlines, etc.) in the community wildfire protection and general wildfire protection zones. Managing wildfire to meet resource objectives in alternative C would be similar to the decision to manage wildfire for resource benefit in the wildland-urban intermix defense zone in alternative A; somewhat limited in the general wildfire zone; and highly encouraged in the wildfire maintenance zone. Prioritizing fuel reduction treatments would be similar to alternative A, based upon project planning due to the uncertainty of the risk to values and resources conveyed by the general wildfire zone. This will continue to allow the accumulation of fuels that contribute to large, unwanted wildfires that damage forests and wildlife habitat, negatively affect stream and watershed quality, reduce air quality with increased smoke, and threaten homes and communities in the wildland-urban intermix.

Consequences Specific to Alternative D

Managing Uncertainty: Alternative D is composed of the same four zones as alternatives B and B-modified: community wildfire protection, general wildfire protection, wildfire restoration and wildfire maintenance (figure 15). These four zones were designed to categorize risk and remove many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets.

Facilitating Wildland Fire Management: Fire management practices in alternative D would provide firefighter safety in all zones while providing asset protection (structures, powerlines, etc.) in the community wildfire protection and general wildfire protection zones.

Summary

The five alternatives are ranked by the measures (managing uncertainty and facilitating fire management) for how they overall address risk management (table 12). As with table 11, these measures were given a numerical rating based on how well they managed uncertainty and how well they addressed facilitating wildfire management. Note that the lower the number, the better the alternative in regard to addressing risk management.

Alternative D has the highest rank (lowest total) because it uses a set of strategic fire management zones that help inform fire management decisions across the fire continuum, while treating more acres (prescribed and mechanical) and managing more wildfires to meet resource objectives. There is more certainty about managing fire for protection objectives in the community and general wildfire protection zones and more certainty about managing fires to meet resource objectives in the wildfire maintenance zone. Alternative D includes direction to strategically treat areas in the wildfire restoration zone to encourage restoring fire as an ecosystem process and lower fire risk over time. Alternatives B and B-modified have the same fire management zones and the same classifications of fire risk as alternative D, but it reduces fuels and restores fire on fewer acres so fire risk remains higher in more areas. Alternative A classifies fire risk in the wildland-urban intermix defense zone and threat zone but doesn't encourage or prepare the landscape for greater management of wildfires to meet resource objectives so the fire risk would remain high in many areas. Alternative C has the lowest rank (highest total) because it classifies fire risk in only the smaller wildland-urban intermix defense zone and in the wildfire maintenance zone but poorly classifies risk in the larger general wildfire zone. Combined with fewer strategic fuel reduction treatments due to plan components for other resource, the fire risk would remain high across most of the national forest in the general wildfire zone but might be reduced similar to alternatives B, B-modified, and D in the wildfire maintenance zone.

Table 12. Summary of approach to wildfire risk management by alternative

Alternative	Indicator	Managing Uncertainty	Facilitating Fire Management	Total
A	Risk Management	3	3	6
B	Risk Management	2	2	4
B-modified	Risk Management	2	2	4
C	Risk Management	4	4	8
D	Risk Management	2	1	3

Air Quality

Background

Air quality is important to human health, visitor experience, vegetation health, soil quality, water quality, and visibility. Both external and internal sources of air pollution that can affect Inyo National Forest lands. Although most of these air pollutants originate outside of the national forest, some of them can have a negative impact on forest health. Management on national forests can make forests more resilient to certain pollutants (Bytnerowicz, Fenn, and Long 2014).

Management actions effect air quality within the plan area, especially through fire emissions such as prescribed burning or managing wildfires to meet resource objectives.

The emphasis in this section is on smoke from prescribed burning and wildfire managed to meet resource objectives since these management actions contribute to air pollution on National Forest System lands but can also influence short- and long-term smoke emissions from unplanned wildfires. The source of other air pollutants is from lands adjacent to the national forest, especially in the San Joaquin Valley and wind-blown dust from Mono Lake and the Owens Valley. For more details on other air pollutants see the Science Synthesis (Bytnerowicz, Fenn, and Long 2014) and the assessments (USDA Forest Service 2013a, 2013b, 2013c, and 2013d).

Federal, State, and local air districts each have rules and regulations that the Forest Service must meet in regards to air quality. The federal Clean Air Act sets forth air quality standards. The standards include regulating concentrations of pollutants such as ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. In addition, visibility goals set forth by the Regional Haze Rule for class I airsheds (wilderness areas) are applicable. Local air district rules and State coordination will be applicable to smoke-producing actions. The Inyo National Forest falls within two different air districts; for additional background information on various air quality designations within the plan area see the Inyo National Forest assessment (USDA Forest Service 2013a). The majority of the national forest is within the Great Basin Unified Air Pollution Control District (figure 23).

Analysis and Methods

This analysis examines the potential air quality impacts from implementation of the proposed forest plan and alternatives. The proposed action is programmatic covering the broad pattern of potential projects and wildfires that can influence air quality. Project-level emissions analysis will take place prior to conducting any smoke-producing management activities.

The assessment of air quality impacts is both quantitative and qualitative. The primary approach compares the tradeoffs between potential smoke emissions from the restoration treatments that reduce the potential wildfire emissions and the wildfire emissions that would occur without the restoration. For more detail on the emissions analysis, see the Fire-climate supplemental report and the Smoke and Air Quality supplemental report. The Carbon Stability supplemental report discusses forest carbon storage and effects of each alternative. This section focuses on regulated air pollutants.

Assumptions

There are many uncertainties about when or where wildfires occur and what potential other sources of smoke may be and how great the emissions. We made several assumptions for this analysis, mostly to address these uncertainties.

- It is unknown exactly, when, where or how much wildfire will occur but the trend of increasing large wildfires and associated high smoke emissions is expected to continue (Hurteau et al. 2014). In addition, research indicates that wildfire emissions are widely underestimated (Liu et al. 2017).

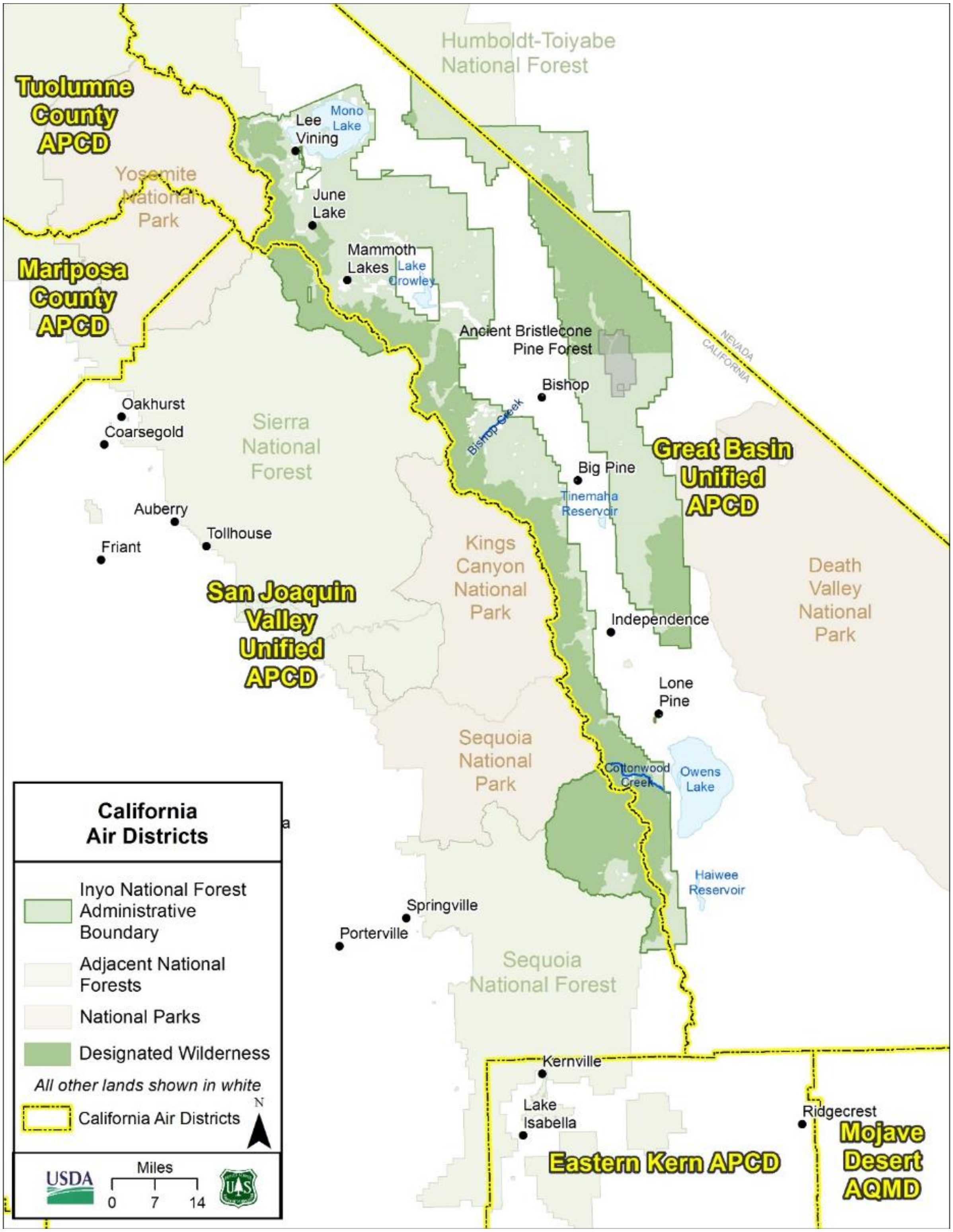

Figure 23. Map of air pollution control districts (APCDs) and Air Quality Management District (AQMD) in and around the Inyo National Forest

- The amount of emissions released by combustion of vegetation will vary depending on the amount of vegetation present and the completeness of combustion. For example, combustion of a stand of Douglas-fir produces more emissions than a sparsely vegetated acre of pinyon-juniper with identical combustion efficiency. Thus, vegetation type is an important factor in quantifying emissions. See the Smoke and Air Quality supplemental report for assumptions of vegetation types under each alternative and corresponding emissions factors.
- Restoration actions that follow the proposed plan and alternatives would result in reduced emissions from wildfires that burn across those areas (Hurteau and North 2009, Hurteau and North 2010, Tarnay and Lutz 2011, Vaillant, Reiner, and Noonan-Wright 2013). Restoration treatments would "offset" future large wildfire emissions. The amount of the reduction depends upon the type and intensity of treatments. See below for a summary of the research on the amount of emissions reductions with forest thinning, biomass removal, mastication, and prescribed fire.
- Smoke management would be practiced actively with all prescribed fire and wildfires managed to meet resource objectives. This would include smoke prediction modeling, smoke monitoring, and close coordination with the local air districts.

Mechanical Thinning, Biomass Removal, and Mastication

Mechanical treatments include thinning trees, removing biomass (smaller trees, shrubs, or larger tree branches), and mastication (where small trees and shrubs are shredded or crushed). Thinning can result in substantially lower emissions during large wildfires (Hurteau and North 2009) and local examples indicate by as much as 90 percent or more (Hurteau, Koch, and Hungate 2008). During large wildfires, woody biomass burns resulting in a release of carbon and smoke. Thinning will occur in each alternative where practical. Machinery use would generate emissions; however, these would be minimal at the plan area level. Project-level analysis will address emissions from machinery.

Smoke from Prescribed Fires and Wildfires Managed to Meet Resource Objectives

All fires produce smoke emissions. The amount of smoke emitted and the area impacted varies with the size of the fire, type of fire, vegetation density, and location. Smoke management is a key aspect of prescribed fires and wildfires managed to meet resource objectives. Prescribed fire activities generally occur under favorable atmospheric conditions for smoke dispersion to limit human health impacts. Wildfires managed to meet resource objectives offer long-term benefits by reducing future wildfire emissions. Research indicates that prescribed burning results in an 18 to 25 percent reduction in smoke emissions, with examples as high as 60 percent (Wiedinmyer and Hurteau 2010). Long-term reductions in emissions from implementation of these activities were modeled (Hurteau et al. 2014). In addition, smoke emissions from wildfires managed to meet resource objectives can be more than five times lower per burned unit area than emissions resulting from large and catastrophic wildfire events, such as the 2013 Rim Fire (Long, Tarnay, and North 2017). The amount of restoration that occurs will affect the amount of emissions reduction from catastrophic wildfires in the long term.

Smoke from Wildfires

In general, large wildfires produce 100 to 1,000 tons of fine particles in smoke per day, moderately sized fires 10 to 100 tons, and small fires less than 10 tons (Tarnay and Lutz 2011). Emissions from wildfires are generally much larger than prescribed fire (Vaillant, Reiner, and

Noonan-Wright 2013). Larger fires have regional impacts, whereas smaller fires have local impacts. Restoration treatments such as mechanical thinning, prescribed fire, and wildfires managed to meet resource objectives can reduce long-term wildfire emissions. Research indicates that smoke emissions from large fires will double during the next half century due to trends in vegetation conditions, climate, and fire ignitions (Hurteau et al. 2014). Increasing smoke emissions identified by Hurteau et al. is a baseline in this analysis.

Indicators and Measures

Three indicators describe the indirect and cumulative effects of each alternative to air quality. A short-term (present to 10 years) or long-term (10 years to mid-century) category describes the timeline of effects to each indicator. The selected indicators consist of smoke effects from alternative implementation on air quality, recreation, and visibility.

Smoke Effects on Air Quality

The smoke effects on air quality indicator is quantitatively measured. Emissions produced by alternative A serve as a baseline to compare emissions produced by actions under alternatives B, B-modified, C, and D. The pollutants analyzed are the criteria pollutants of total organic gases (TOG), reactive organic gases (ROG), carbon monoxide (CO), nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM), particulate matter less than 10 micrometers (PM_{10}), and particulate matter less than 2.5 micrometers ($PM_{2.5}$). Long-term, indirect, and cumulative effects from implementation is analyzed using modeled future emissions (Hurteau et al. 2014). This indicator is comprised of two categories of emissions: wildfires and restoration treatments. Restoration treatments include mechanical treatments, prescribed fire, and managing wildfire to meet resource objectives.

Smoke Effects to Recreation

The smoke effects to recreation indicator is qualitatively measured. Smoke obscures visibility and impacts recreation through visitor avoidance of smoke impacted areas. Long-term, indirect, and cumulative effects from implementation are analyzed using modeling information (Hurteau et al. 2014).

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

The Forest Service, along with other agencies, monitors class I wilderness areas through the Interagency Monitoring of Protected Visual Environments (IMPROVE) network. There are two sites within the Inyo National Forest, the Kaiser Wilderness and Hoover Wilderness. This monitoring network measures pollutant concentration and visibility. The presence of air pollution can affect how clearly the human eye perceives distant objects or scenery. The smoke effects to visibility in class I airsheds indicator will be quantitatively assessed. Current trends are compared to long-term modeled impacts (Hurteau et al. 2014).

Affected Environment

The air quality on the eastern side of the Sierra Nevada, including the Inyo National Forest, mostly meets air quality standards except when wildfire smoke is present. At this time, the eastern side of the Sierra is in attainment of State and Federal standards. Overall air quality within the region is largely outside of the control of the Forest Service except for smoke management on National Forest System lands of some fires. Smoke management opportunities are limited during large wildfires. There has been a trend in increased large wildfires and associated heavy smoke emissions. The level of smoke emissions from large wildfires is expected to double over the next

50 years, given current vegetation conditions and trends in climate and fire ignitions (Hurteau et al. 2014). There have been a limited number of prescribed fires in the last decade (see “Fire Management” section). Some wildfires managed to meet resource objectives have occurred in the southeastern portion of the Inyo National Forest in the Kern River drainage.

Environmental Consequences to Air Quality

Consequences Common to all Alternatives

Each alternative proposes differing amounts of treatments resulting in differing impacts to air quality. Current air district emissions server as a baseline to analyze impacts to the indicators and measures of air quality, recreation, and visibility. Background information collected during the assessment phase on air quality within the plan area was included in this analysis.

The southern Sierra Nevada fire-climate study investigated reductions in projected wildfire emissions under differing levels of restoration (see the “Fire Trends” section). Figure 24 shows the reductions in projected wildfire smoke emissions with four different restoration scenarios. This graph was based upon a climate projection called the GFDL (Geophysical Fluid Dynamics Laboratory) A2 climate scenario and it assumed that the fires burn with high severity and high emissions.

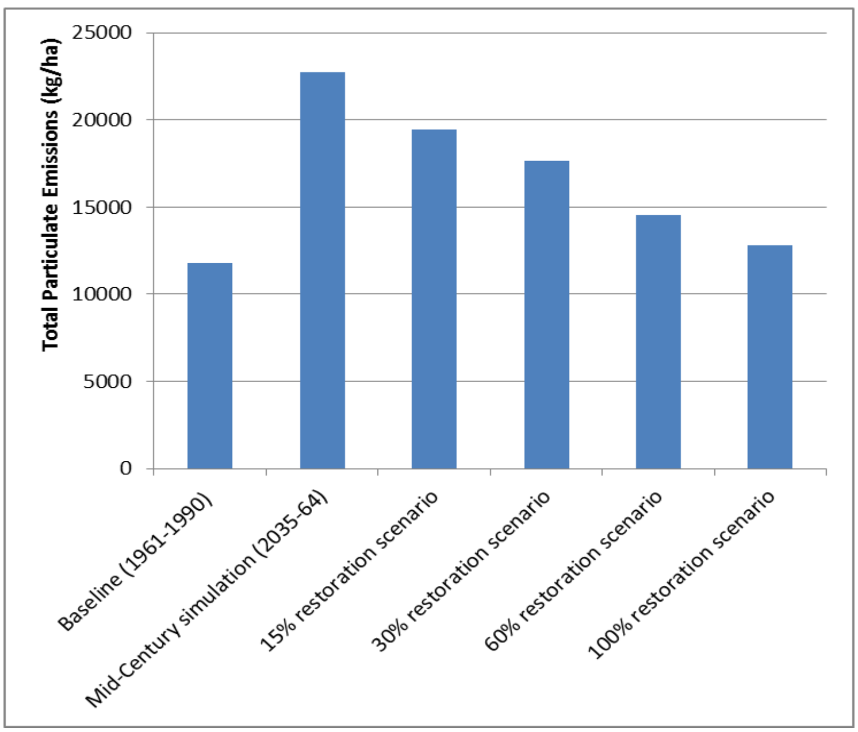

Figure 24. Graph displaying modeling results of particulate matter emissions from wildfires under differing treatment scenarios at mid-century (Hurteau et al. 2014). The baseline and mid-century simulations represent a 5-10 percent restoration scenario. See table 5 for a comparison of restoration levels by alternative.

Figure 24 shows that with climate projections, smoke emissions are predicted to double from the model’s point of reference level from 1961 to 1990 labeled as “baseline.” The second bar represents the current trend of wildfire emissions into the future labeled “Mid-Century simulation." The remaining bars indicate future wildfire emission reduction comparing total particulate emissions measured in kilograms per hectare (kg/ha) from different treatment levels. The same relationships were applied to the indirect and cumulative effects of each alternative.

Based on the fire-climate simulations, wildfire emissions would continue to increase and double from current conditions by mid-century with some limited exceptions (Hurteau et al. 2014). All alternatives would have beneficial reductions in potential wildfire smoke emissions where restoration treatments occur; however, the degree of long-term improvement depends on the level of restoration (figure 24). Uncertainty of analysis exists when considering when, where, and how much of a large wildfire will overlap with restoration treatments.

The "Mid-Century simulation" represents alternative A emissions in the long-term. Under Alternative A with restoration occurring at the current pace of treating 5 to 10 percent of the landscape, long-term emissions will greatly increase. Restoration ranges between the 15 and 30 percent represent alternatives B and B-modified. Under this scenario, some long-term reduction in emissions will occur. Restoration scenarios between the mid-century simulation and 15 percent treatment represent long-term emissions reduction under alternative C. Restoration scenarios between the 30 and 60 percent of treatment represent long-term results in emissions reduction under Alternative D. There are some levels of increasing emissions long-term even under full treatment compared to the baseline emissions of 1961-1990.

Consequences Specific to Alternative A

Under alternative A, there would continue to be limited restoration treatments (such as prescribed burning and mechanical treatments) that would reduce fuels and potentially reduce emissions during large wildfires. This alternative represents current management and resulting emissions. The primary impact from alternative A would be a continuation of current trends in large wildfires that produce large smoke emissions.

Smoke Effects on Air Quality

In alternative A, there would be a continuation of current trends in large uncharacteristic wildfires that contribute to reduced sustainability of air quality as modeled by Hurteau et al. (2014). Because emissions from wildfires are largely uncontrollable and can be large in scale, they result in large air quality impacts. In addition, wildfires may occur during times of unfavorable atmospheric conditions resulting in a compounded air quality effect. Smoke from wildfires tends to be of higher intensity than prescribed fires and managers have little control to limit emissions. Consequences include adverse effects on human health, particularly for residents of communities in that path of smoke events.

Alternative A would not contribute to changing current trends or improve the sustainability of air quality benefits to people. See table 13 for an estimate of annual emissions from alternative A. The table shows emissions in tons per year and modeled mid-century emissions with no change in management from today. The annualized increase in emissions is primarily due to the trend of increasing wildfire in this alternative at mid-century. This alternative serves as a baseline for comparison of each alternative. Emissions figures represent the most recent reported annual emissions from the Great Basin Valleys Air Basin (California Air Resources Board 2013).

There would be a moderate to substantial intensity of the associated short- and long-term effects to air quality across a large geographic area from alternative A. Air quality would degrade due to increased wildfire emissions in the long term (mid-century). In the short term, treatments would cause a sporadic reduction (as treatments occur) of impacts to air quality from wildfires and prescribed burning. Mechanical pre-treatment of vegetation can reduce smoke impacts from prescribed fire.

Table 13. Table displaying air basin baseline annual emissions in tons per year and emissions under alternative A

Reference	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Annualized baseline air district emissions	8,359	1,898	219	17,776	2,409
Annualized alternative A emissions	10,896	68	57	1,018	863
Annualized percent increase of emissions	57	3	21	5	26

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 or 2.5 micrometers in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

Smoke Effects to Recreation

There would be no change in the current trends of forest conditions that result in smoke due to wildfire in the short term. In the long term, smoke from wildfire will increase, leading to reduced recreational visitation on the national forest. There is also loss of benefits to the recreational users who must find other settings for their recreational activities. Substitute recreation sites may offer less opportunities or lower quality of the experience. In addition, substitute sites may be located farther away than the preferred site, thus increasing costs of recreating. Some recreational users may also choose not to recreate at all due to air quality conditions.

There is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience that contributes to quality of life. Rural communities located along access routes to the national forest have a strong tie to the economic contributions that recreational visitors provide. This includes the spending that supports jobs and contributions to local tax revenues through the sales tax and lodging tax collected. These local tax revenues support important public services that improve the quality of life in these communities. The connection between recreation visitation and local economies is especially true for the Inyo National Forest and the context of recreational-based, service-oriented businesses within Inyo and Mono Counties. Alternative A does not contribute to altering current trends or improve the sustainability of these recreational benefits to people. Increasing wildfire emissions have potential adverse long-term effects on local community economics.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

In general, data from the three IMPROVE sites show that visibility is currently increasing within the plan area (USDA Forest Service 2013a). However, modeling indicates that wildfire emissions will significantly increase by mid-century (Hurteau et al. 2014). Long-term increasing emissions will contribute to reduced visibility throughout the plan area. Visibility in class I airsheds is regulated under the Regional Haze Rule and the Forest Service is responsible for meeting goals set forth by the Environmental Protection Agency. Implementation of alternative A would make attaining these goals unlikely as wildfire emissions increase. Under alternative A, smoke impacts to visibility will be low to moderate in the short term and increase to high in the long term.

Consequences Specific to Alternative B

In alternative B, there would be more prescribed fire, mechanical thinning, and in some areas, wildfires managed to meet resource objectives than in alternative A. All of these restoration activities would reduce potential emissions from large, undesirable wildfires. There would be increased smoke emissions from prescribed fires, but levels of smoke would be substantially lower (45 percent less) than during wildfires and result in immediate post-fire reductions in potential wildfire smoke emissions (Vaillant, Reiner, and Noonan-Wright 2013).

Smoke Effects on Air Quality

Alternative B would contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. Prescribed burning in this alternative would have a potential short-term adverse effect on air quality, but conducting them under favorable atmospheric conditions can mitigate impacts. Wildfires managed to meet resource objectives similarly consider the impacts of smoke, although there is less control than for prescribed fires. The mechanical thinning proposed in the alternative would reduce the quantity of smoke that would occur during prescribed fire activities and for wildfires managed to meet resource objectives by reducing the amount of fuels available to burn.

The Forest Service does not have direct control over pollution outside of the Inyo National Forest but can contribute to air quality enhancement by limiting the smoke from wildfires. In the long term, implementation of alternative B would indirectly improve air quality compared to alternative A by reducing the potential for large wildfires, and therefore reducing emissions. Reductions in emissions from mechanical pre-thinning of vegetation was not included and actual emissions are likely to be lower (table 14). Actual emissions and smoke impacts depend on additional factors such as seasonality of implementation, meteorology, and combustion efficiency. In the short term, alternative B would increase emissions during implementation. By mid-century, alternative B will decrease emissions from wildfires (Hurteau et al. 2014).

Table 14. Emissions from treatments under alternative B measured in tons per year and compared to the air basin baseline

Reference	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Annualized baseline air district emissions	8,359	1,898	219	17,776	2,409
Annualized alternative B emissions	26,739	183	146	2,510	2,129
Annualized percent increase of emissions	76	9	40	12	47

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 or 2.5 micrometers in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

There would be a moderate intensity of the associated short- and long-term effects to air quality across a large geographic area under alternative B. Air quality would improve through wildfire emissions reduction in the long term (mid-century). In the short term, treatments would cause a sporadic reduction (as treatments occur) of impacts to air quality from wildfires, but would have pulses of impact associated with prescribed burning and wildfires managed to meet resource objectives.

Smoke Effects to Recreation

Alternative B would contribute to reducing current trends in forest conditions that result in smoke due to wildfire. Reductions in smoke events have potential beneficial short- and long-term effects on local community economics due to reductions in interruptions to visitation. There is a corresponding potential for short-term reductions in air quality due to increases in prescribed burning. Mechanical pre-thinning of vegetation prior to treatment would reduce smoke impacts to recreational visitation during implementation. Most prescribed burning occurs in the late fall through spring, outside of the peak recreation season. Long-term impacts from wildfire smoke to recreation would be lower in this alternative than alternatives A and C, thereby improving the sustainability of recreational benefits to people.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

Effects to the visibility in class I airsheds under alternative B represent a trade-off. In the short term, increased emissions would reduce visibility in the class I airsheds within the analysis areas. In the long-term, treatments under alternative B would reduce wildfire emissions and thus improve visibility in class I airsheds by mid-century. In general, data from three IMPROVE sites show that visibility is currently increasing within the plan area (see Assessment). However, modeling indicates that wildfire emissions would significantly increase by mid-century (Hurteau et al. 2014). Increasing emissions will reduce visibility throughout the plan area when wildfires are present. Restoration treatments can improve visibility through the reduction of emissions in the long term.

In the short term, moderate to substantial intensity impacts resulting in decreased visibility could occur in class I airsheds during implementation. More smoke would occur in the short term under this alternative compared to A and C. This effect would decrease after restoration treatments are complete. In the long term, a more resilient landscape would increase the likelihood of meeting visibility goals by the mid-century.

Consequences Specific to Alternative B-modified

Air quality effects both beneficial and adverse under this alternative would be similar to alternative B.

Smoke Effects on Air Quality

Alternative B would contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. The prescribed burning and wildfire use to meet resource objectives in this alternative would have a potential short-term adverse effect on air quality (table 15). Conducting treatments under favorable atmospheric conditions can mitigate impacts. Wildfires managed to meet resource objectives similarly consider the impacts of smoke, although there is less control than for prescribed fires. The mechanical thinning proposed in the alternative would reduce the quantity of smoke that would occur during prescribed fire activities and for wildfires managed to meet resource objectives by reducing the amount of fuels available to burn.

There would be a moderate intensity of the associated short- and long-term effects to air quality across a large geographic area under alternative B-modified. Air quality would improve through wildfire emissions reduction in the long-term (Hurteau et al. 2014). In the short term, treatments would cause a sporadic reduction in air quality as treatments occur.

Table 15. Emissions under alternative B-modified in tons per year compared to the air basin baseline

Reference	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Annualized air basin baseline emissions	19,255	1,966	276	18,793	3272
Annualized alternative B-modified emissions	29,274	199	159	2,747	2,329
Annualized percent increase of emissions	60	9	37	13	42

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 microns or 2.5 microns in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

Smoke Effects to Recreation

Alternative B-modified would contribute to reducing current trends in forest conditions that result in smoke due to wildfire. Reductions in smoke events have potential beneficial short- and long-term effects on local community economics due to reductions in interruptions to visitation. However, there is a corresponding potential for short-term reductions in air quality due to increases in prescribed burning. Mechanical pre-thinning of vegetation prior to treatment would reduce smoke impacts to recreational visitation during implementation. Most prescribed burning occurs in the late fall through spring, outside of the peak recreation season. Long-term impacts from wildfire smoke to recreation would be lower in this alternative than alternatives A and C. Long-term changes in wildfire emissions in this alternative is expected to be similar to B. Long-term reductions to wildfire emissions would improve the sustainability of recreational benefits to people.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

In general, data from the three IMPROVE sites show that visibility is currently increasing within the plan area (see Assessment). Meeting the class I airsheds goals will be more likely under this alternative than A and C. Modeling results indicate that wildfire emissions will increase somewhat under this alternative by mid-century (Hurteau et al. 2014). Short-term impacts to visibility may sporadically occur during treatment implementation.

Consequences Specific to Alternative C

Alternative C increases the amount of treatment compared to alternative A. This would result in short-term smoke emissions, but potential reductions in large wildfire smoke emissions in areas where large prescribed burns occur. Completing prescribed fire activities under favorable atmospheric conditions can mitigate smoke impacts as opposed to wildfire. However, there is uncertainty about feasibility of implementation of this alternative because of limitations on mechanical treatments. These limitations would result in less treatment of strategic areas along roads and ridgetops. This alternative is less likely to result in a decrease of particulate matter emissions by mid-century than all other alternatives except A (Hurteau et al. 2014).

Smoke Effects on Air Quality

Alternative C would contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality to the extent that large landscape prescribed burning occurs. The prescribed burning would have a potential short-term negative effect on air quality, but completing these activities under favorable atmospheric conditions can mitigate smoke impacts. There is less mechanical thinning proposed under this alternative than B and D leaving more fuels to burn during implementation with greater quantities of smoke produced.

Alternative C would contribute to altering current trends and improving the sustainability of air quality benefits to people. The emissions estimates were conservatively modeled and no reduction techniques, such as pre-treatment thinning of vegetation, were included (table 16). Actual emissions and smoke impacts depend on additional factors such as seasonality of implementation, meteorology, and combustion efficiency. In the short term, alternative C would increase emissions due to treatment implementation. By mid-century, alternative C would reduce some wildfire emissions but not as aggressively as alternatives D, B-modified, and B.

Table 16. Emissions from treatments under alternative C measured in tons per year and compared to the air basin baseline

Reference	Carbon Monoxide	Nitrogen Oxide	Sulfur Oxide	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Annualized air district baseline emissions	8359	1898	219	17776	2409
Annualized alternative C emissions	25730	162	136	2405	2039
Annualized percent increase of emissions	75	8	38	12	46

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 microns or 2.5 microns in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

There would be a moderate intensity of the associated long-term effects to air quality across a large geographic area and a moderate to substantial intensity of associated short-term effects. Air quality would improve through reduced wildfire emissions in the long term (mid-century) where treatments occurred. In the short term, treatments would cause a sporadic reduction (as treatments occur) of air quality impacts from wildfires. There would be pulses of impact associated with prescribed burning and wildfires managed to meet resource objectives that would be larger than alternatives B and D due to less fuel reduction with mechanical methods resulting in more fuels to burn.

Smoke Effects to Recreation

Alternative C contributes to reversing current trends in forest conditions that result in smoke due to wildfire. Reductions in smoke events have potential beneficial short- and long-term effects on local community economics due to reductions in interruptions to visitation. There is a corresponding potential for short-term reductions in air quality due to increases in prescribed burning and wildfires managed to meet resource objectives. The net-effect on air quality is more uncertain under alterative C than alternatives B and D given there is less mechanical thinning occurring before any prescribed burning. There would be mitigation measures considered to control when and where prescribed burning and managing wildfires to meet resource objectives can occur in order to reduce smoke exposure. There would also be additional benefit to the recreational users who are able to enjoy recreational activities in the national forest when wildfires would otherwise prevent visitor use.

Like alternatives A and B, there is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience that contributes to quality of life. Alternative C would also contribute to altering current trends to improve the sustainability of recreational benefits to people. A moderate to substantial intensity of smoke that would affect recreation across a large geographic area from the associated short- and long-term effects of implementing alternative C.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

Effects to the visibility in class I airsheds under alternative C represent a trade-off. In the short-term, if fully implemented, increased emissions from prescribed fire and wildfires managed to meet resource objectives would reduce visibility in the class I airsheds within the analysis areas. In addition, limitations to mechanical pre-thinning of vegetation will result in less mitigation of smoke impacts during implementation. In the long-term, treatments under alternative C would reduce emissions from wildfires and thus improve visibility in class I airsheds by mid-century. However, not to the same degree as alternative D, B, and B-modified.

Consequences Specific to Alternative D

Alternative D would have the greatest amount of restoration activities, including prescribed fire, mechanical thinning, and wildfire managed to meet resource objectives. Based on the fire-climate scenarios (see “Fire Trends” section) this would result in a substantial reduction in potential wildfire emissions. At mid-century, there would still be an increase in emissions over current levels but far less than the projected doubling of smoke emissions under alternative A (Hurteau et al. 2014).

Smoke Effects on Air Quality

Alternative D contributes to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. Emissions from wildfires would still occur; however, the trend of increasing mega fires would slow by mid-century due to treatments (Hurteau et al. 2014). The amount of prescribed burning and wildfire managed to meet resource objectives in this alternative would have adverse short-term effects on air quality greater than all other alternatives (table 17). However, due to the level of treatments, long-term emissions from wildfires would be lowest under this alternative.

Implementing treatments under favorable atmospheric conditions can mitigate smoke impacts to some extent as well as pre-thinning of vegetation. Reductions in emissions from mechanical pre-thinning of vegetation was not included in the analysis and actual implementation emissions may lower. Smoke impacts depend on additional factors such as seasonality of implementation, meteorology, and combustion efficiency.

Table 17. Emissions under alternative D in tons per year compared to the air basin baseline

Reference	Carbon Monoxide	Nitrogen Oxides	Sulfur Oxides	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$
Annualized air basin baseline emissions	8,359	1,898	219	17,776	2,409
Annualized alternative D emissions	46,146	318	252	4,334	3,675
Annualized percent increase of emissions	85	14	54	20	60

PM_{10} and $PM_{2.5}$ refer to particulates that are 10 microns or 2.5 microns in size. Those are sizes used in standard measurements of particulate matter for compliance with air quality regulations.

Smoke Effects to Recreation

Alternative D would contribute the most to reducing current trends in those forest conditions that result in smoke due to wildfire effects. Reductions in smoke events have potential beneficial short- and long-term effects on local community economics due to reductions in interruptions to visitation. There is a corresponding potential for short-term reductions in air quality due to increases in prescribed burning and wildfires managed to meet resource objectives. Mechanical pre-thinning prior to treatment and coordination between agencies to mitigate the effect of smoke on recreational visitation.

As with the other alternatives, there is an economic contribution provided by recreation to both local communities through visitation and to recreational users through the recreational experience that contributes to quality of life. Alternative D would contribute to altering current trends in air quality to improve the sustainability of recreational benefits to people in the long term. However, there would be a moderate to substantial intensity of the associated short-term effects of alternative D to air quality across a large geographic area.

Smoke Effects to Visibility in Class I Airsheds (Wilderness)

Like the other alternatives, increased emissions from prescribed fire and mechanical treatments in alternative D would reduce visibility in the class I airsheds within the analysis areas in the short term. In the long term, treatments under alternative D would reduce wildfire emissions and thus improve visibility in class I airsheds by mid-century. Restoration treatments can improve visibility through the reduction of emissions in the long term.

With the increased amounts of restoration and reduction in smoke from future wildfire, implementing alternative D increases the likelihood of attainment in class I airsheds by the mid-century. In the short term, moderate to substantial intensity impacts resulting in decreases in visibility to class I airsheds would occur during implementation of prescribed burning. In the long term, moderate to substantial intensity impacts resulting in improved visibility in class I airsheds is expected.

Cumulative Effects

The Forest Service does not have direct control over pollution generated off national forest lands but can contribute to air quality enhancement within the plan area by completing treatments that limit smoke emissions from wildfires. Increasing the use of fire as a treatment for wilderness and remote areas is consistent with approaches of the National Park Service and Bureau of Land Management.

In the short term, close coordination exists between various agencies to manage cumulative effects of smoke on a daily interagency coordination call. Frequent attendees include representatives from the Sierra, Sequoia, and Inyo National Forests, Sequoia and Kings Canyon National Parks, San Joaquin Valley Unified Air Pollution Control Districts, Great Basin Valleys Air Pollution Control District, and others. This daily call limits the amount of smoke produced within the airsheds of the plan area to prevent cumulative impacts to day-to-day air quality. In the short term, implementation of all alternatives would add cumulatively to air quality issues; however, intensity would vary by the amount of treatment implemented. In the short term, alternative A would result in fewer cumulative impacts followed by alternatives C, B, B-modified, and D. This trend would reverse in the long term with restoration of ecosystem resilience (Hurteau et al. 2014). Long-term air quality impacts from the Inyo National Forest management actions is modeled to be lowest under alternative D followed by B-modified, B, C, and A.

Analytical Conclusions

Effects to air resource indicators from each alternative are categorized by timeframes of short-term (present to 10 years) and long-term (10 years to mid-century). Effects to air resource indicators are categorized by emissions source-type of either wildfire or restoration treatments (prescribed fire, wildfire managed for resource benefit, and mechanical thinning) as shown in table 18. No alternative offers both short-term and long-term improvements to air resource indicators. Models indicate wildfire emissions will increase through time and are considerably greater than restoration emissions. Restoration treatments would slow the progress of increasing wildfire emissions. The degree of slowing wildfire emissions growth through time depends on the level of treatments.

Table 18. Summary of air quality indicators and effects by alternative

Smoke effects indicator	Alternative A	Alternative B	Alternative C	Alternative D	Alternative B-modified
Air quality	Short-term, emissions stay the same. Long-term, emissions increase	Short-term, emissions increase. Long-term, emissions reduced	Short-term, emissions increase. Long-term, emissions reduced	Short-term, emissions increase the most. Long-term, emissions reduced the most	Short-term, emissions increase. Long-term, emissions reduced.
Recreation	Short-term effects stay the same. Long-term, more smoke effects	Short-term, more smoke effects. Long-term, slightly less smoke effects	Short-term effects stay the same. Long-term, more smoke effects	Short-term, more smoke effects. Long-term, greatest reduced smoke effects.	Short-term, more smoke effects. Long-term, slightly less smoke effects.
Visibility in class I airsheds	Attainment unlikely	Attainment more likely	Attainment likely	Attainment most likely	Attainment more likely

Restoration activities would increase emissions and affect air quality in the short term, but the degree of increase is dependent on the amount of treatment. Alternative D has the highest short-term emissions from treatments followed by alternatives B-modified, B, C, and A In the long term, alternative D would result in the greatest reduction in emissions from wildfires followed by alternatives B-modified, B, C, and lastly, A. Smoke management best practices can moderate short-term effects to air resource indicators from restoration activities.

There would be potential adverse short- and long-term effects on recreational visitation. In the short term, current trends of increasing impacts to recreation would continue in alternative A due to smoke from wildfires that burn during the summer recreation season. In addition, treatment timing can avoid smoke impacts during peak visitation periods. There would be less smoke in the long term in alternatives B, B-modified and D, where wildfires burn into areas where treatments occurred. There would be less benefit in alternative C due to the low amounts of treatment. In the long term, impacts to recreation are expected to increase with increasing wildfire emissions in alternative A, but to a lesser degree in alternatives B-modified, B, and slightly lesser degree in alternative C. Only alternative D would decrease the long-term smoke from wildfires in the summer recreation season due to the greater amount of fuels reduced.

Increases in emissions and other cumulative effects would make long-term attainment of visibility goals unlikely under alternative A. Restoration treatments under alternatives B, B-modified, and D would result in a reduction in smoke emissions by mid-century. Reduction in wildfire emissions would make long-term attainment of visibility goals more likely under alternatives B, B-modified, and D than under alternative A (figure 24). The prescribed burning restoration treatments under alternative C would result in reduced smoke emissions by mid-century and, to the extent that prescribed burning and wildfires managed to meet resource objectives occur. A reduction in wildfire smoke would make long-term attainment of visibility goals more likely than under alternative A but less likely than under alternatives B, B-modified, and D. Short-term impacts would lessen throughout time as fuels are reduced and would increase visibility in the long term.

Revision Topic 2: Ecological Integrity

Background

The topic of ecological integrity is very broad and spans from terrestrial to aquatic ecosystems. It includes the organisms that live in these ecosystems as well as the functions of the ecosystems themselves. To address this revision topic, the analysis is divided into three sections: terrestrial ecosystems; aquatic and riparian ecosystems; and wildlife, fish and plants. This topic also relies heavily upon the information provided in the “Agents of Change” section. The major vegetation types are discussed in the “Terrestrial Ecosystems” section and that discussion is referred to by other sections in this document.

Terrestrial Ecosystems

The terrestrial ecosystems analysis is presented in three subsections: terrestrial vegetation ecology, terrestrial ecosystem process and function, and climate vulnerabilities and adaptations.

Terrestrial Vegetation Ecology

Background

This section summarizes current terrestrial ecosystem conditions of dominant vegetation types on the Inyo National Forest, and the consequences of implementing the final forest plan or the alternatives. It includes an analysis of the alternatives’ effects on vegetation ecology including composition, structure, and resilience to fire, climate, drought, insects, and pathogens by major ecological zone and vegetation type. Building upon the “Agents of Change, Climate, Fire, Insects and Pathogens” section, there are more specifics about fire regime integrity and effects by vegetation type.

Much of the analysis is based upon the premise that the natural range of variation provides important background for evaluating ecological integrity and sustainability (Wiens et al. 2012, Manley et al. 1995). It was used to develop plan direction and select indicators and measures for the analysis. Also important in the analysis of ecological integrity and sustainability of vegetation was consideration of climate and associated fire trends that may be creating a combination of conditions that are outside of what occurred in the natural range of variation (Safford, North, and Meyer. 2012, Millar and Stephenson 2015).

Natural range of variation is a concept that focuses on the dynamic nature of ecosystems, recognizing they are not static or narrowly bound in their representative attributes (Landres, Morgan, and Swanson 1999b). This concept is relevant to ecosystem attributes such as vegetation composition, structure, and function that influence ecosystem values and services such as wildlife habitat. Natural range of variation is typically characterized as the ecosystem conditions and processes that have occurred over long time periods that are appropriate for a given management application (Morgan et al. 1994, Wiens et al. 2012). While natural processes such as fire are part of the ecosystem that contributes to the natural range of variation, it is recognized that human actions following Euro-American settlement have dramatically changed vegetation and fire regimes in the analysis area. Because of these changes, the natural range of variation is typically analyzed for the time period prior to European settlement; generally mid- to late-1800s, depending on vegetation type. A basic premise is that ecosystems currently have greater integrity and are more sustainable if their conditions fall within the natural range of variation (Safford et al. 2012).

Application of natural range of variation concepts also recognize that native cultures managed and influenced ecosystem conditions and processes (Jackson and Hobbs 2009). For example, in the analysis area, Native American Tribes actively used fire to manage resources of tribal importance, such as vegetation and game (Lake and Long 2014b).

Although the concept of natural range of variation and its use in sustainable ecosystem management is well developed from a theoretical standpoint, its application in resource management is not always straightforward. For example, sometimes an important measure of vegetation structure used to characterize wildlife habitat, such as canopy cover, is not directly or easily reconstructed historically. Or, quantitative information on historic conditions, such as tree densities, may only be available for a short period of time just before or at the onset of European settlement. Despite these limitations, it is still considered a useful way to evaluate the very important but complex concept of ecological sustainability. It is also increasingly recognized that human presence and needs may result in desired ecological conditions that are different than the natural range of variation (Higgs et al. 2014). Vegetation desired conditions for the proposed plan take into account not only natural range of variation, but also current societal desires for supporting recovery of endangered species and reducing fire near communities.

During the assessment phase, terrestrial ecosystems were classified into broad ecological zones, based upon similarities in dominant vegetation types, climate, and fire patterns at a landscape scale. These broad ecological zones were used to analyze and summarize conditions and impacts of the alternatives to vegetation ecology and terrestrial function in the following subsection. The ecological zones include Sierra Nevada montane zone (also referred to as “montane”), subalpine and alpine zone, and eastside shrublands and woodlands as shown in figure 25 (see the maps in volume 3 to see ecological zones by alternative). The Sierra Nevada montane zone includes forest and other vegetation (Jeffrey pine, dry mixed conifer, red fir, and wet and dry lodgepole pine forests) at mid-elevations in the Sierra Nevada and Glass Mountains. The subalpine and alpine zone includes high-elevation (generally above 10,000 feet) vegetation in the Sierra Nevada and White, Inyo, and Glass Mountains. The eastside arid shrublands and woodlands vegetation group includes sagebrush, pinyon-juniper woodlands, mountain mahogany, and xeric shrublands and blackbrush. Three other vegetation types are described but not shown on these maps due to their small and localized distribution: aspen, and black oak/canyon live oak. The area in acres in each ecological zone is shown in table 19.

Table 19. Area in acres by ecological zone or vegetation group, rounded to the nearest thousand acres

Ecological Zone/ Vegetation Group	Acres
Montane	339,000
Subalpine/Alpine	465,000
Eastside shrublands and woodlands	1,168,000

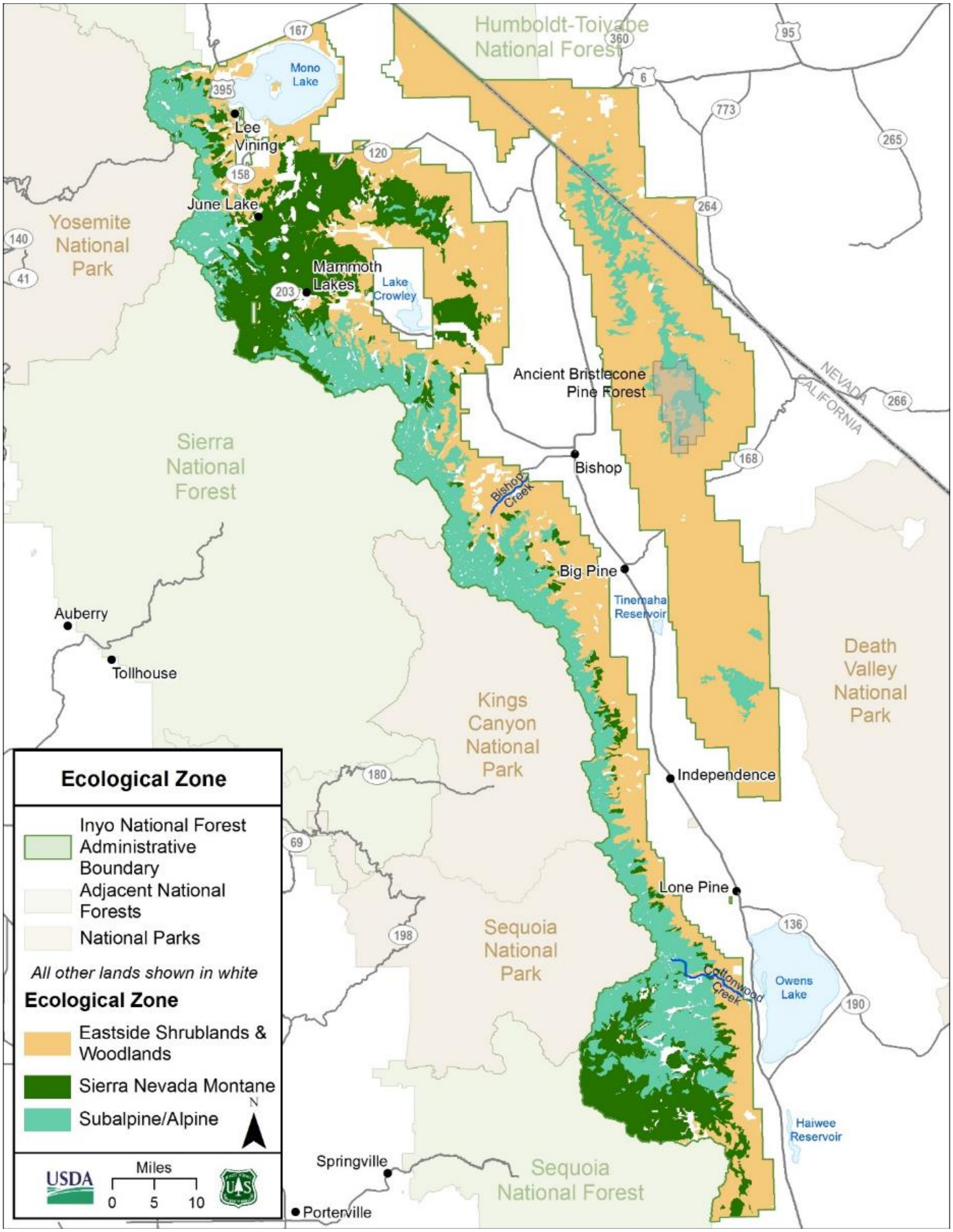

Figure 25. Ecological/vegetation zones groups on the Inyo National Forest

Analysis and Methods

The overarching approach we used in this analysis was to evaluate the similarity of current and estimated future conditions under each alternative to the desired conditions for each vegetation type. We used a combination of qualitative and quantitative analysis. For both types of evaluations, we identified the specific indicators, measures, thresholds for levels of similarity between desired conditions and current or future conditions, and associated assumptions. These are described in more detail in the Vegetation Ecology and Fire Ecology supplemental reports.

The desired conditions for vegetation and other terrestrial ecosystems are all directly related to the natural range of variation. For each major vegetation type, we developed desired conditions for vegetation structure, composition and function that were specific and quantitative where possible. For example, there has been extensive research on how forest density has changed over the last 100 or more years (Stephens et al. 2015, Collins, Everett, and Stephens 2011, Collins et al. 2015) and other research on how forests differ between areas in national parks that have had little direct management except fire suppression and where over the past 40 years, fires have been restored (Lydersen and North 2012, Lydersen et al. 2013). This research includes information on dominant species, tree densities of different tree sizes, variation in tree spacing or heterogeneity, and evidence of high fire severity. There are some desired conditions that strive for a balance between habitat needs for at-risk species and the natural range of variation. That includes having more areas of sagebrush cover for greater sage-grouse and structurally-diverse old-forest habitat for California spotted owl (not uniformly high canopy cover across the landscape).

The choice of specific measures used in the desired conditions depends on a combination of what conditions are used to characterize suitable wildlife habitat, what is important for ecological integrity and sustainability, what is most departed from the natural range of variation, and what is most useful to apply to restoration projects. Canopy cover is an example that is important to wildlife habitat, is known to be outside the natural range of variation and can be used to apply to restoration projects. Tree density is more difficult to relate to habitat and sustainability because it varies so widely from site to site. Basal area is a measure of forest density that incorporates aspects of tree density and tree sizes, and is available from the natural range of variation research and is very useful in restoration project design. Because of these considerations, desired conditions were developed for canopy cover at the landscape scale and within patches, and basal area was used to measure forest density.

Indicators and Measures

There are several main aspects to vegetation ecology that were used for this analysis.

Composition. Composition includes the mix of plant species. The analysis looks at predicted changes to overstory and understory composition. For the overstory, we considered the primary tree species, such as amount of pinyon-juniper in sagebrush areas (eastside). For the understory, we considered the mix of native flowering plants, shrubs and grasses and presence and extent of nonnative, invasive plants.

Structure. Structure includes the type of plants (trees or shrubs), how big individual plants or trees are, how dense they occur, and how they are arranged, such as uniformly or in a clumpy or heterogeneous pattern. Vegetation structure at the landscape scale was characterized by the amount of vegetation in the California Wildlife Habitat Relationships classes (Mayer and Laudenslayer Jr 1988). At the patch scale, we analyzed forest density, represented by canopy cover and basal area. We used heterogeneity (variability in tree spacing, sizes and openings) to analyze within-patch structure.

Vegetation types as described by California Wildlife Habitat Relationships classes are useful in comparing the proportion of the landscape in forested versus nonforested areas, and the amount of open versus close-canopied, or small- versus large-tree-dominated patches. While they are sometimes equated to seral stages (stages of forest development), there is not necessarily a one-to-one correspondence. For example, very open small-tree-dominated woodland at high elevations may be a very old subalpine forest. The stand size characteristic is based upon the average stand diameter. When forests consist of mixtures of tree sizes or diameters, this can make it difficult to distinguish younger from older forests. The California Wildlife Habitat Relationships classification does not reflect aspects of structure that are important to many wildlife species, such as large trees and snags (North 2012b). The analysis of old forest characteristics, including the proportion of the landscape in old forest, large tree densities, and restoration approaches for large and old trees in old forests, are described in greater detail in the Old Forest supplemental report. Despite the short-comings of the California Wildlife Habitat Relationships classification, it is what has been applied for multiple decades. It is still used in part to characterize wildlife habitat suitability for some of the species of conservation concern analyzed in this plan. Because of its continued use in wildlife models, it was analyzed here.

Resilience to Fire, Climate, Drought, Air Pollutants, Insects and Pathogens. Resilience is a measure of the elasticity of an ecosystem; that is, its ability to absorb disturbances or stressors such as severe droughts and insect outbreaks and to maintain or quickly recover its intrinsic ecological characteristics (composition, structure, and function) and ecosystem services (such as provide habitat or soil protection). For this analysis, the ability of terrestrial ecosystems, especially vegetation, to withstand drought, warmer temperatures, high-intensity fires and insect and pathogen outbreaks was analyzed. In the previous section on climate, the broader capacity of ecosystems to respond to climate change was covered. Resilience to fire was addressed in the context of the natural range of variation of fire regimes.

Two different measures were used to reflect ecological fire resilience. In forested ecosystems, we used the intensity and type of fire, such as surface or crown fire. In non-forest and woodland ecosystems, we used fire return interval departure and presence of nonnative annual grasses to analyze resilience. For both of these measures, the analysis was at a landscape scale, since fires and vegetation responses can vary from site to site. The aggregate of all of those effects and resilience to fire is most important for ecological impacts.

Analysis Methods and Data Sources

We used a combination of scientific summaries, scientific research, and existing and available vegetation information for the analysis. This included Forest Inventory and Analysis plot data and remote sensing, satellite data. Most of the information included in the “Affected Environment” section was based upon the bio-regional and forest assessments (USDA Forest Service 2013a, 2013b, 2013c, and 2013d). These included information from the “Living Assessment” (USDA Forest Service 2013e, 2013f, 2013g, and 2013h), published scientific literature, the “Scientific Synthesis” (Long, Quinn-Davidson, and Skinner 2014b), and the “Natural Range of Variability Assessments” (Safford and Stevens 2017, Estes 2013a and 2013c, Merriam et al. 2013, Meyer 2015b and 2015c, Sawyer 2013b, Slaton and Stone 2015a and 2015b). This information was used to evaluate the conditions of the indicators relative to desired conditions and analysis thresholds.

For each indicator and vegetation type or ecological zone, we evaluated potential effects on composition, structure, and resilience at the programmatic level for each alternative. This entails identifying plan direction relevant to the vegetation type for each alternative and making projections about the potential effects of future implementation of that plan direction. The specific timing and location of potential restoration projects is not known but the types of effects associated with implementation can be discussed. The evaluation of potential effects to composition, structure, and resilience associated with plan implementation is based on scientific literature (and professional experience) that has examined the effects of treatments similar to those that would be implemented under alternatives B, C, and D using fire-climate modeling (see "Fire Trends" section, (Westerling, Milostan, and Keyser. 2015), and ecological fire resilience modeling (USDA Forest Service 2013a, e 2013b, 2013c, and 2013d).

Most of the earlier literature on the ecological restoration of Sierra Nevada montane forests has focused on fuels treatments. More recently, there has been an increase in ecological restoration for vegetation composition, structure, and ecological function. Much of the associated research on ecological restoration for mixed conifer and yellow pine (ponderosa and Jeffrey pine) forests has been summarized in two recent technical reports, GTR 220 and 237 (North, Stine, O'Hara, et al. 2009, North 2012a)), and the recent "Science Synthesis for the Sierra Nevada Bioregion" (Long, Quinn-Davidson, and Skinner 2014a). Red fir restoration is also addressed in the Science Synthesis to some degree. Restoration management strategies and treatments proposed and described in those documents are the basis for management direction contained in alternatives B, B-modified, C, and D.

For sagebrush and pinyon-juniper ecosystems, we examined several recent comprehensive scientific literature reviews and management strategies directed at restoration of greater sage-grouse habitat (Chambers et al. 2007, Wisdom and Chambers 2009, Arkle et al. 2014, Chambers et al. 2013, Chambers et al. 2014). This includes reducing conifer density in sagebrush areas, prevention and restoration of areas with nonnative, invasive annual grasses, and restoration of perennial grasses.

For some vegetation types there are multiple applicable research papers, and for readability only key ones were cited here. Additional scientific research on the effects of different restoration management activities specific to different vegetation types are summarized in the Vegetation Ecology supplemental report.

The analysis is displayed in two ways. First, there is a narrative for each indicator by major vegetation type that explains the potential consequences of implementing the different type, amount, and location of restoration activities. Second, there is an overall rating of whether the indicator has a low, moderate, or high similarity to desired conditions. This rating is based upon the degree of departure (and especially the proportion of the landscape with departure of current or expected future conditions) from the desired conditions and natural range of variation. The criteria and thresholds for the ratings were identified for each major vegetation type and indicator and are displayed in the Vegetation Ecology supplemental report. The tables for montane Jeffrey pine and dry mixed conifer (table 20) and eastside sagebrush and pinyon-juniper (table 21) are included below because these are the primary vegetation types that would be managed.

Thresholds for evaluating condition of vegetation indicators were based upon scientific literature where available and, where not available, on general ecological theory (that is, percolation theory, (Turner 1989), research on landscape vegetation conditions and changes in fire patterns (Parisien, Junor, and Kafka 2007; Parisien et al. 2010 and 2012; Westerling, Milostan, and Keyser 2015), and logical categories. There is limited scientific literature that specifies what proportion of a landscape needs to be in a certain condition to have ecological integrity. Landscape ecology theory provided an overall basis for setting the high and low ecological condition thresholds (Turner 1989). Percolation theory distinguishes changes in landscape processes and functions when less than 40 percent of a landscape is in a different condition. This could include fragmentation of habitat, movement of wildlife, or movement of fire. Research on fire probabilities (extent, large fire size and severity) suggest that landscapes with at least 40 percent in a condition that is more consistent with the natural range of variation have a reduced likelihood of fire probability and large fire size, and areas with more than 60 to 75 percent have a substantially reduced likelihood (Parisien, Junor, and Kafka 2007; Parisien et al. 2010 and 2012; Westerling, Milostan, and Keyser 2015).

Table 20. The indicators, measures and criteria for evaluating the current condition and consequences for the Sierra Nevada montane zone (and dry mixed conifer) composition

Vegetation/ Ecosystem Type	Indicator	Measure	Criteria
Dry mixed conifer	Overstory composition	Similarity of dominant overstory tree composition to desired conditions (over 60 percent pine in mixed conifer)	High: meet conditions on most (over 60 percent of area) of the landscape Moderate: meet conditions on some (40-60 percent of area) of the landscape Low: meet conditions on limited (less than 40 percent of the area) of the landscape
Jeffrey pine and dry mixed conifer	Understory composition	Understory – native plant composition, abundance and condition (improved with openings and fire restoration)	High – open canopy (similar to desired conditions) dominant, with restoration of fire common: over 60 percent area Moderate – same as above but 30-60 percent area Low – same as above but less than 30 percent area
Jeffrey pine and dry mixed conifer	Overstory structure	Similarity of overstory stand structure to desired conditions (within the natural range of variation with respect to tree densities, canopy cover, basal area, tree size class distribution)	High: meet conditions on most (over 60 percent of area) of the landscape Moderate: meet conditions on some (40-60 percent of area) of the landscape Low: meet conditions on limited (less than 40 percent of the area) of the landscape

Table 21. The indicators, measures and criteria for evaluating the current condition and consequences for eastside ecological zones and vegetation types

Vegetation/ Ecosystem Type	Indicator	Measure	Criteria
Sagebrush	Composition	Similarity of understory composition and condition to desired condition (areas of native perennial grasses and flowering plants thriving and increasing, native shrubs healthy)	High: meet conditions on many areas (over40 percent area); Moderate: meet conditions on some (20-40 percent) of the area; Low: meet conditions on limited (less than 20 percent) of the area;
Sagebrush	Composition	Presence of conifer trees (pinyon, juniper, Jeffrey pine) in historically tree free areas	High: less than 10 percent of sagebrush area invaded by conifers Moderate: 10 to 30 percent of sagebrush areas invaded by conifers Low: more than 30 percent of sagebrush areas invaded by conifers
Sagebrush	Structure	Similarity of seral stage mosaic to desired condition (within the natural range of variation; areas of sage-grouse nesting and brooding/rearing habitat within desired conditions	High: meet conditions on most (over 60 percent of area) of the landscape Moderate: meet conditions on some (40-60 percent of area) of the landscape Low: meet conditions on limited (less than 40 percent of the area) of the landscape
Sagebrush	Structure	Age structure and condition of shrubs (decadence)	High: shrub age structure diverse and within the natural range of variation on most of landscape (over 60 percent of area) Moderate: same as above for some of area (40 to 60 percent area) Low: same as above for little of the area (less than 40 percent area)
Pinyon-juniper	Composition	Similarity of species composition to desired condition (limited nonnative invasive grasses or plants, primarily cheatgrass)	High: few to no invasive plants Moderate: limited frequency of occurrence and slow rates of spread Low: moderate to high frequency of occurrence and rates of spread
Pinyon-juniper	Structure	Pinyon pine regeneration, mature trees and pinyon nut production	High: most (over 60 percent) of the area within desired condition Moderate: some (40-60 percent) of the area within desired condition Low: limited (less than 40 percent) area within desired condition
Xeric Shrub-black brush	Composition	Native species composition; invasive species (occurrence, density and number of species); native soil crusts are intact	High: few to no invasive plants; native plants and soil crusts in good condition over most (over 98 percent of the area) Moderate: limited frequency of occurrence and slow rates of spread of invasive plants and/or disruption of soil crusts (under 5 percent area) Low: moderate to high frequency of occurrence and rates of spread; and disruption of soil crusts over increased area (over 5 percent area)
Xeric Shrub-black brush	Structure and resilience	Presence of nonnative plants, especially annual grasses	See above

We made reasonable assumptions that:

- the majority (greater than 60 to greater than 75 percent) of a landscape in condition within the natural range of variation or similar to desired conditions would have high ecological integrity;
- nearly half (greater than 40 to greater than 50 percent) of a landscape in condition within the natural range of variation or similar to desired condition would have moderate ecological integrity; and
- less than that would have low ecological integrity (less than 20 to less than 40 percent)
- The characterization of the natural range of variation of fire severity in Sierra Nevada forest ecosystems (including the characterization of high severity fire proportion and patch size) is based on a large volume of best available science information summarized in Safford (2013), Meyer (2013a, b), Long et al. (2014c), North et al. (2009, 2012a), and other sources cited in the "Agents of Change" section. These comprehensive best available science information summaries only include information sources that meet criteria for best available science information as defined by the 2012 Forest Planning Rule as accurate, reliable, and relevant to the issues being considered. In particular, valid best available science information is characterized by several features, including but not limited to: (1) quantitative analysis was performed using appropriate statistical or quantitative methods, (2) logical conclusions and reasonable inferences were drawn, (3) science uses well-developed scientific methods that are clearly described, and (4) information is placed in proper context including spatial and temporal scales.[23] Information sources that do not meet these criteria or characteristics of best available science information (Baker 2014, Odion et al 2014, Hanson and Odion 2014, Odion and Hanson 2016), were not included or cited in the evaluation of fire regime natural range of variation in Sierra Nevada forest ecosystems used in the final environmental impact statement and revised forest plan. Moreover, several recent best available science publications (Levine et al. 2017, Stevens et al. 2016, Fulé et al. 2014, Stephens et al. 2015, Miller and Safford 2017, Safford, Miller, and Collins 2015, Safford et al. 2008), disprove the best available science information validity of the aforementioned publications due to: (1) a series of serious analytical and methodological issues, (2) unreasonable inferences and inappropriate conclusions drawn, (3) scientific methods and analyses poorly developed and described, (4) science information placed in inappropriate ecological context, and (5) other related issues (such as technical references inappropriately cited and placed out of context). For these reasons, these information sources were not considered valid best available science information for the evaluation of fire regime integrity or resilience in Sierra Nevada ecosystems.

Affected Environment

Current conditions are first summarized overall and then later described by ecological/elevation zone and vegetation type. The distribution and area in major vegetation types are shown in table 22 and figure 26. Note that the vegetation map for the Inyo National Forest is based upon the Terrestrial Ecological Unit Inventory. Some of the smaller patches were merged with adjacent larger patches. The information has not been updated for recent fires occurring since 2009. (However, updates for vegetation changes since the large, recent fires before 2015 were made to the underlying fuels layers used to model ecological fire resilience). In addition, vegetation on the

[23] FSH 1909.12 - Land management planning handbook, Chapter 42.12

ground would show more detail and smaller patches of varying vegetation types than represented in these figures.

Table 22. Acres of major vegetation types, Inyo National Forest[1]

Vegetation/Ecosystem Type	Ecological Zone/Vegetation Group	Acres
Pinyon-juniper	Eastside shrublands and woodlands	563,884
Subalpine conifer forest	Subalpine/alpine	335,453
Sagebrush	Eastside shrublands and woodlands	309,426
Xeric shrub and blackbrush	Eastside shrublands and woodlands	213,971
Jeffrey pine	Montane	135,106
Alpine	Subalpine/alpine	129,845
Red fir	Montane	118,061
Mountain mahogany	Eastside shrublands and woodlands	81,683
Lodgepole pine[2]	Montane	48,004
Special type	Unique vegetation type	49,490
Dry Mixed conifer	Montane	45,692
Aspen	Unique vegetation type	12,462
Black oak/Canyon live oak	Unique vegetation type	393

1. Vegetation types based on the California Wildlife Habitat Relationships classification (for Sierran Mixed conifer) and the Inyo National Forest Terrestrial Ecosystem Unit Inventory classification (for all other vegetation types).
2. Includes wet and dry lodgepole pine ecosystem types.

Hardwood types are important for wildlife species and some of the species of conservation concern. These were broken out by dominance of the primary species such as black oak, canyon live oak, or aspen. Table 23 below shows the area of vegetation dominated by different hardwood species.

Table 23. Area in acres in different hardwood vegetation types rounded to the nearest hundred acres

Regional Dominance Type*	Inyo National Forest Acres
Black Oak	246
Canyon Live Oak	4,155
Quaking Aspen	16,780

* Defined by California Wildlife Habitat Relationships classifications

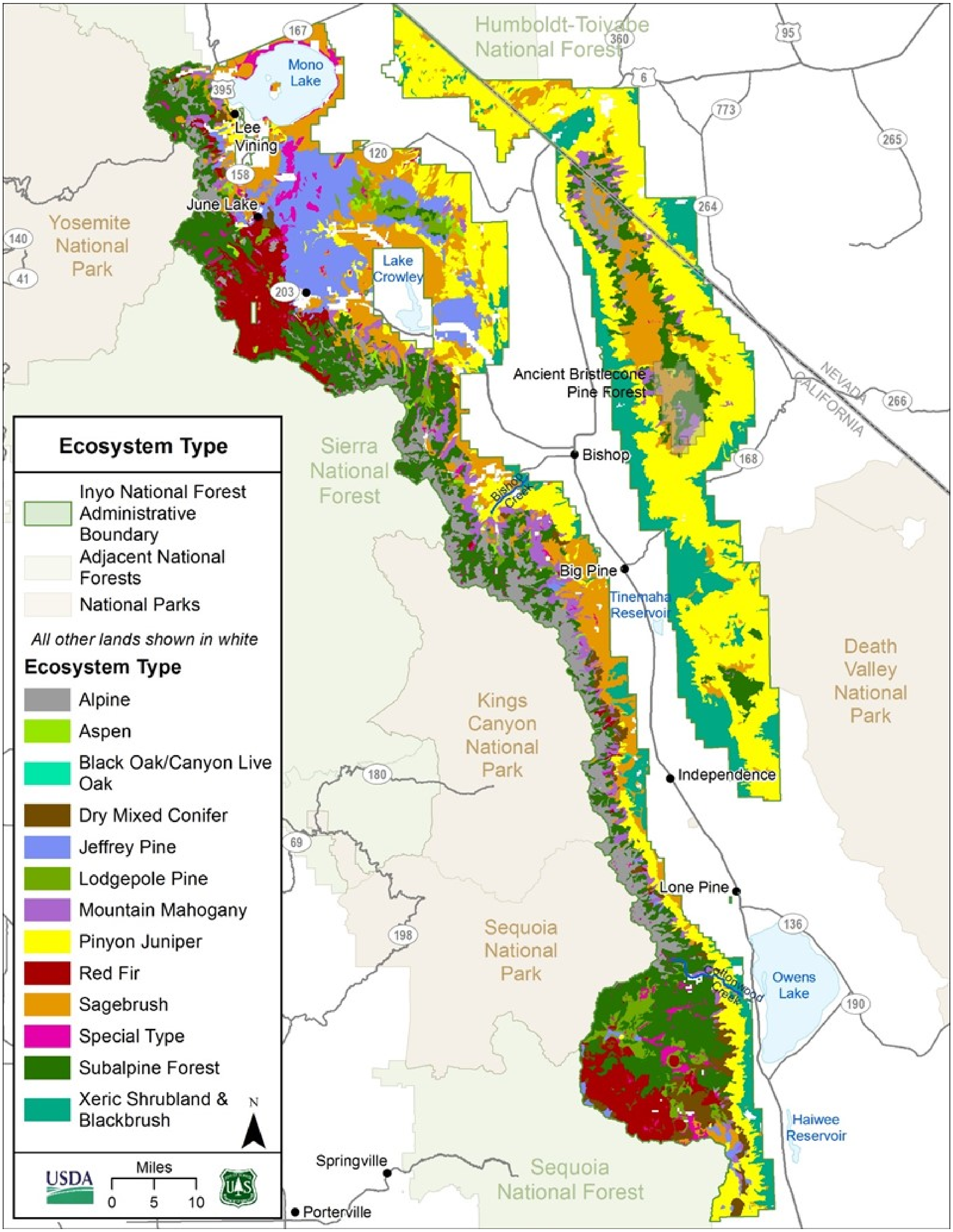

Figure 26. Major ecosystem types from the Terrestrial Ecological Unit Inventory, Inyo National Forest

Summary of Similarity of Current Conditions to Desired Conditions

Based on the assessments for individual major vegetation types, the current conditions show a high similarity with desired conditions for only a few types, particularly the alpine and subalpine types. For the majority of vegetation types, especially those in the montane and Great Basin ecological zones, the vegetation characteristics exhibit a low to moderate similarity with the desired conditions. A summary of the current condition compared to the desired conditions are shown in table 24 for eastside vegetation types and ecological zones.

Table 24. Comparison of current conditions to desired conditions vegetation types and ecological zones[1]

Vegetation Type	Vegetation Composition Overstory	Vegetation Composition Understory	Vegetation Structure Density	Vegetation Structure Heterogeneity	Drought, Climate Resilience	Fire Resilience
Sagebrush	not applicable	low	moderate	low	moderate	moderate
Pinyon-juniper	high	moderate	moderate	low-moderate	moderate	low-moderate
Mountain mahogany	not applicable	moderate	moderate	moderate	moderate	moderate
Jeffrey Pine	Moderate to high	Moderate to high	low	low	low	low
Dry mixed conifer	low	low	low	low	low	very low
Red fir-Moist Lodgepole pine	high	moderate	low	low-moderate	low	low
Subalpine/ Alpine	high	moderate-high	moderate to high	moderate to high	moderate	moderate to high
Desert Shrub/ Blackbrush	not applicable	moderate-high low	not applicable	not applicable	moderate	low

1. Comparison of vegetation structure, composition, or function is based on a qualitative assessment of similarity between current and desired conditions. Low similarity indicates that current conditions are dissimilar to desired conditions (e.g., tree densities and forest biomass are outside the desired variation), and high similarity indicates that current conditions are similar to desired conditions (e.g., overstory tree composition is within the natural range of variation).

Vegetation in the Kern River drainage is covered separately in table 25 because the current condition of most resident vegetation types differs substantially from the rest of the Inyo National Forest. This is because of the extensive restoration of wildfire managed to meet resource objectives in this more remote area over the last 15 years (Fites-Kaufman, Noonan, and Ramirez 2005, Ewell, Reiner, and Williams 2012, Meyer 2015a). This area also has a substantially different current condition and similarity to desired conditions. It spans westside to eastside vegetation, but is mostly similar to the westside conditions. It is described at the end of the vegetation section.

Table 25. Comparison of current conditions to desired conditions, vegetation types and ecological zones in the Kern River drainage[1]

Ecological Zone	Vegetation Composition Overstory	Vegetation Composition Understory	Vegetation Structure Density	Vegetation Structure Heterogeneity	Drought, Climate Resilience	Fire Resilience
Montane	moderate to high	moderate to high	moderate to high	moderate to high	moderate	moderate to high
Subalpine/ Alpine	high	moderate-high	moderate to high	moderate to high	moderate	moderate to high

1. See table note for table 24 footnote for description of low, moderate, and high ratings.

Ecological Zones and Vegetation Types

There are three broad ecological zones in the plan area: Sierra Nevada montane, subalpine and alpine, and eastside shrublands and woodlands. Each of these zones spans a wide elevational gradient that contains multiple vegetation or ecosystem types adapted to local variations in climate, soils, topography, and natural disturbance regimes. In the following sections, each of these three zones and their component ecosystem or vegetation types are described in greater detail.

Sierra Nevada Montane Zone

The Sierra Nevada montane zone in the plan area contains a patchy mosaic of forest, shrub, and herb-dominated (meadow) vegetation types that change with elevation, topography, soils, climate, and prior disturbance history. Dry mixed conifer, Jeffrey pine, red fir, lodgepole pine, and mountain mahogany are the primary upland vegetation types (mountain mahogany occurs in the montane, subalpine and alpine, and eastside shrubland and woodland ecological zones). Extensive meadows and riparian areas also occur in many areas of this zone, especially within drainages and lower topographic positions. Fire is an especially important ecological process in the montane zone, influencing composition, structure, and resilience (van Wagtendonk and Fites-Kaufman 2006). Decades of fire exclusion, timber harvest prior to the 1990s, widespread sheep grazing prior to the early 20th century, and patterns of increasing high-severity fire in many of these landscapes have resulted in changes at the landscape scale (Meyer et al. 2014a, Safford et al. 2013c). Most forest areas have become more dense and uniform in structure. Increased high-severity fire has also resulted in greater degrees of forest fragmentation and reduced forest connectivity. These patterns of increasing fragmentation resulting from stand-replacing fire were often linked to warming climate and, in fire-excluded forests characterized with a frequent fire regime (such as Jeffrey pine forests), increased fuel loading (Miller and Safford 2012). Although tree mortality levels in the Sierra Nevada montane zone on the Inyo National Forest are likely in the upper portion of the natural range of variation, future warming climate trends and hotter droughts in the region will result in future tree mortality that will exceed the natural range of variation (Allen, Breshears, and McDowell 2015; Safford 2013; Safford and Stevens 2017).

Dry Mixed Conifer Forests

Although not as prevalent in the eastern Sierra Nevada as other forest types, dry mixed conifer forests do occur in moderately-sized patches in isolated areas on the Inyo National Forest, mostly on the Kern Plateau and also on the eastern escarpment. Here, dry mixed-conifer forests contain a mixture of Jeffrey pine and white fir, sometimes including lodgepole pine and, at higher elevations, some red fir (Safford and Stevens 2017, Fites-Kaufman et al. 2007). These are the relatively productive areas, where a combination of climate and soils provide ideal growing conditions for trees and other vegetation. Historically, these productive forests had the most frequent fire, averaging 5 to 20 years (Safford et al. 2013b, van Wagtendonk and Fites-Kaufman 2006). Frequent fires swept through the understory, keeping understory tree densities and surface fuels low. There was thought to be a high level of structural variation, with varied tree sizes, densities, spacing, and arrangements, collectively called “heterogeneity” (North, Stine, O'Hara, et al. 2009).

Current vegetation composition, structure and resilience of dry mixed conifer forests are highly dissimilar to desired conditions, except in the Kern Plateau and Kern River drainage. Conditions have changed considerably since before European settlement (van Wagtendonk and Fites-Kaufman 2006, Fites-Kaufman et al. 2007, Van de Water and Safford 2011, Collins, Everett, and Stephens 2011, Lydersen and North 2012, Safford and Van de Water 2014, Collins et al. 2015, Stephens et al. 2015), and are largely outside the natural range of variation in most of the montane zone (Safford and Stevens 2017, Merriam et al. 2013).

Composition of the overstory and understory in this ecosystem type has changed substantially. Jeffrey pines have decreased in dominance and shade-tolerant species, especially white fir, have increased (North, Stine, O'Hara, et al. 2009). Increases in tree density, and decreases in frequent, low- and moderate-intensity fires have impacted understory shrubs, grasses and flowering plants (van Wagtendonk and Fites-Kaufman 2006, Fites-Kaufman et al. 2007, Wayman and North 2007, Webster and Halpern 2010). These plants have evolved with fire and some of them have adaptations, such as the ability to sprout from bulbs or roots, or fire-stimulated seed germination that enables them to thrive with fire. Other plants, such as Jeffrey pine, need bare soil to germinate and survive. As a result, in the absence of frequent fire, the understory flora of shrubs, flowering plants, and grasses, is less diverse and in poor condition.

Forest structure in dry mixed conifer has changed in several ways. Forest density is higher, canopy cover of trees more uniformly higher, small and medium tree density is higher, and large tree density is lower (Collins, Everett, and Stephens 2011; Collins et al. 2015; Stephens et al. 2015). Within-stand variation in tree size and density has decreased substantially (Lydersen et al. 2013). Large tree densities and distribution across the landscape is substantially lower in most places than historically (USDA Forest Service 2001b, Franklin and Fites-Kaufman 1996, Fites-Kaufman et al. 2007, Stephens et al. 2015). Until recently, the low levels of large trees were due to past harvest from the European settlement period to the 1980s (Mckelvey and Johnston 1992).

More recently, water stress, climate change, and possibly air pollutants have weakened large trees (Panek et al. 2013; Bytnerowicz, Fenn, and Long 2014). Outside of fires, large tree mortality has doubled in the last two to three decades across the western United States (Van Mantgem et al. 2009). This pattern is associated with increases in temperature and droughts. There are also high levels of air pollutants, primarily ozone and possibly nitrogen that are impacting forest health and contributing to increased tree mortality to an unknown degree (USDA Forest Service 2013a and 2013d). Ozone weakens trees, especially yellow pines including Jeffrey pine, and makes them more susceptible to drought and insects (see “Air Quality” section). These stresses are compounded by the competition for water from the dense, younger trees that surround many old trees (McDowell et al. 2008, Franklin and Johnson 2012).

Resilience of dry mixed conifer forests to high-intensity fire, drought, insects, pathogens, climate change, and air pollution is very low in most areas (Safford et al. 2013c, North 2012b, Collins and Skinner 2014a). Dense vegetation contributes to higher intensity fire and increased tree mortality from fires. Dense forests are more vulnerable to stress brought on by drought, insects, pathogens, and air pollution. Currently, in dry mixed conifer forests there has been and continues to be elevated tree mortality, especially in white fir and red fir. Mortality is extending up into the higher elevations in mixed conifer forests based upon aerial surveys conducted by the USDA Forest Service State and Private Forestry program (see figure 8 and figure 9 in the “Insects and Pathogens” section). However, mortality levels are not as extensive on the eastside as on westside forests. This mortality is primarily resulting from a combination of hotter drought (driven by warming climate trends) and insects. There may also be a contribution from ozone weakening the trees. This not only reflects decreased resilience but is also resulting in decreased forest diversity and heterogeneity.

Fires in dry mixed conifer are less frequent but evidence is strong that they are on average larger and more severe in large uniform areas, than before European settlement (Collins and Skinner

2014a, Safford et al. 2013c). Changes in fire have contributed to shrinking chaparral patches scattered within forests (Estes 2013a). Most of the montane area is likely to burn as crown fires during peak fire weather conditions. The mix of fire types (crown and surface fires), and resulting severity (high to moderate or low) is difficult to predict precisely. There are many conditions that influence the type and effects of fires including the time of day, condition of the vegetation, and dryness of the vegetation and fuels. Overall, the more continuously dense vegetation is and dry, the more likely large areas of crown fire will occur. Recent trends in fires have been increased proportions of crown fire and high-severity effects to forests, especially in dry mixed conifer and yellow pine forests (Miller and Safford 2012; Steel, Safford, and Viers 2015).

Jeffrey Pine Forests

Jeffrey pine forests are scattered along the escarpment of the Sierra Nevada, on the Kern Plateau, Glass Mountains, Mono Valley, and Upper Owens River area. This forest type generally occurs on shallow, less productive soils on middle to upper slope positions. Eastside Jeffrey pine forests typically occur in “pure” stands dominated by Jeffrey pine. In some areas it may be mixed with pinyon pine, white fir, red fir, lodgepole pine, western white pine, or limber pine. The understory usually consists of a low cover of herbaceous plants or shrubs such as sagebrush or bitterbrush.

Composition is low to moderate in its similarity to desired conditions. The overstory has had less fire and therefore an increasing proportion of white fir, red fir, and lodgepole pine. But in most areas, Jeffrey pine remains the dominant tree species. The understory has had more changes and has a low similarity to desired conditions. This is due to an increase in nonnative, annual grasses that displace native understory plants. Fire suppression and grazing have also resulted in changes in understory composition.

Stand structure conditions in eastside Jeffrey pine forests are different from desired conditions. Tree densities have increased, and there has been a considerable shift in the tree size class distribution to smaller diameters, a decrease in heterogeneity and greater uniformity of forest structure at patch and landscape scales, increased canopy cover, and a general decrease in the density of large-diameter Jeffrey pine trees (Safford and Stevens 2017). There is a deficit of open-canopy mature and old forests throughout the plan area. Surface fuels and small trees that serve as ladder fuels are greater than the desired condition.

Resilience of Jeffrey pine forests is low to very low. Increased density has made them more susceptible to drought, insects and pathogens, climate change, and high-intensity fire-related mortality (figure 27). Climate projections of eastside Jeffrey pine forests suggest this forest type will shift upwards to the higher elevations on the eastside Sierra Nevada (Finch 2012, Schwartz et al. 2013b, Thorne et al. 2017).

Figure 27. Recently dead and dying Jeffrey pines in eastside pine stand on the Inyo National Forest

Red Fir Forests

Red fir forests are common in upper montane landscapes of the southern Sierra Nevada. This forest type is dominated by red fir and typically occurs on deeper, more productive soils on most slope positions except ridgetops. Mixed red fir stands may also contain white fir at lower elevations and lodgepole pine, Jeffrey pine, western white pine, or mountain hemlock at higher elevations (Potter 1998). The understory may include several species of shrubs or herbaceous plants, including pinemat manzanita, greenleaf manzanita, huckleberry oak, chinquapin, snowberry, Utah serviceberry, mountain whitethorn, pine-woods lousewort, and Brewer's golden aster.

Tree species composition is generally similar to the desired conditions, but understory species cover and diversity in fire-excluded stands is at the lower end of the desired conditions and the natural range of variation (Meyer et al. 2014a).

Current stand structure conditions in red fir forests are dissimilar to desired conditions. There has been a considerable shift in the tree size class distribution to smaller diameters. Forest structure at the stand and landscape scales is more uniform and less heterogeneous. There has been a decrease in the density of large-diameter red fir trees in many areas (Meyer et al. 2014a). Younger and intermediate-sized trees are denser than the desired condition, and there is a deficit of open-canopy mature and old forests in most of the plan area.

Resilience of red fir forests to drought, insects, pathogens, climate change and high-intensity fire is moderate but declining. Tree mortality rates associated with pathogens and moisture stress in red fir forests is increasing at a rate that will soon exceed the desired conditions and natural range of variation (Mortenson, Gray, and Shaw 2015). Climate vulnerability of red fir forests is relatively high compared to other vegetation types (Meyer 2013a). Because red fir is associated with colder winters and snow, it is particularly vulnerable to climate change. Resilience to high-intensity fire is moderate. Higher stand density, more uniform forests have resulted in increased high severity areas. Although some areas of high severity are within the natural range of variation (van Wagtendonk and Fites-Kaufman 2006), larger patches of high severity are becoming more common with drought and hot and dry weather.

Lodgepole Pine Forests

This vegetation type is further divided into dry versus wet lodgepole pine. Dry lodgepole pine dominates in higher elevation dry sites generally above 8,500 feet elevation, often located on benches, upper topographic positions, and moderate slopes. Stands are typically in broken terrain and shallow, drier, and nutrient-poor soils. Western white pine may be present, but mesic tree species (such as red fir and mountain hemlock) are generally absent or infrequent. Understory herbaceous plant cover is generally less than 30 percent and bare ground and rock cover is generally more than 30 percent. Either wet or dry lodgepole may border some meadow ecosystems, depending upon the ecological setting.

Wet lodgepole pine dominates in higher elevation wet sites generally above 7,500 feet elevation, often located on gently rolling lower slopes and drainage bottoms. Stands are located on relatively productive, moister, and deeper soils in the montane zone. Red fir or mountain hemlock may be present in wet lodgepole pine stands. Understory herbaceous plant cover is generally more than 30 percent and bare ground and rock cover is generally less than 30 percent. Either wet or dry lodgepole may border some meadow ecosystems, depending upon the ecological setting.

Unique Landscapes within the Sierra Nevada Montane Zone

The Kern River drainage is a unique landscape in the Sierra Nevada montane zone that includes the Kern Plateau, located east of the Kern River, which dominates the center of the Sequoia National Forest and a small area on the southwest portion of the Inyo National Forest. The canyon where the Kern River drains is also included in the Kern River drainage, especially in the north and middle sections of the watershed. Much of this area is remote and steep and as a result there have been multiple wildfires that have been managed to meet resource objectives in this area over the past 15 years (Meyer 2015a). Most of the area is within the montane zone. Some of the fires in the area have been very large, and mostly high intensity and severity, including the McNally Fire. This was in the western portion, partly outside of the Kern River drainage. Most of the McNally Fire was not beneficial because it had very large patches of high-severity fire, but the majority of the fires have been beneficial and have resulted in substantial movement toward desired conditions (Fites-Kaufman, Noonan, and Ramirez 2005, Ewell, Reiner, and Williams 2012, Meyer et al. 2015).

On the Kern Plateau, extensive fires have occurred over the last 15 years in a range of weather conditions. Because the area is very dry, increases in forest density have been less dramatic than other mixed conifer areas. There has been less ingrowth of white fir. Because of these more moderate changes in forest density and composition, the effects of the fires in the last 15 years have been less severe in many areas. For many of these fires, there has been a greater proportion of moderate- and low-intensity fire and resulting low- and mixed-severity effects. As a result, large areas have had reductions in forest density toward the desired conditions. There has been an increase in heterogeneity at the landscape, patch and within-patch scales in forests and chaparral. These fires have restored understory plant composition and condition, since the majority of the species are adapted to and may benefit from fire. This includes the riparian areas. Examples include lupines, aspen, grasses and other sprouting plants. Overall, montane forests in much of the Kern Plateau have a moderate to high similarity to desired conditions. The area has a moderate to high resilience to drought, insects, pathogens, climate change, and high-intensity fire. This is apparent in lower levels of tree mortality and increasingly restricted sizes of large fires. This has happened multiple times, mostly recently on the Rough and Cabin Fires on the Sequoia National Forest in 2015 (Reiner et al. 2016).

Subalpine and Alpine Vegetation Zone

The subalpine and alpine zone occurs at the highest elevations of the eastern Sierra Nevada and White, Inyo, and Glass Mountains in the Great Basin. This zone is characterized by mostly steep slopes, poorly-developed granitic-based soils, and a very high percentage of precipitation that falls as snow (van Wagtendonk and Fites-Kaufman 2006). The primary vegetation types in this zone include subalpine forests and alpine communities dominated by either shrubs or herbs that are often patchily distributed across the landscape (Potter 1998). Warming climate trends in the plan area are likely to lead to increased fragmentation and reduced connectivity of subalpine and alpine vegetation, especially in the latter half of the 21st century (Lenihan et al. 2008, Schwartz et al. 2013b, Thorne et al. 2017). These broad-scale changes have important implications for a wide array of species dependent on subalpine and alpine environments, especially southern Sierra Nevada endemics such as foxtail pine (*Pinus balfouriana* subspecies *austrina*), alpine chipmunk, granite draba, Sierra Nevada leptosiphon, and sweet-smelling monardella (Meyer et al. 2014a, Rundel 2011).

Subalpine landscapes in the eastern Sierra Nevada contain a number of species that are absent or rare on the westside, such as limber pine. There are other species that are limited in distribution to other areas in the eastside and Great Basin, notably the Great Basin bristlecone pine (referred to as 'bristlecone pine' hereafter). The White, Inyo, and Glass Mountains contain other subalpine and alpine species only found on the eastside of the Sierra Nevada, such as the bristlecone cryptantha, July Gold, White Mountains draba, and White Mountains wild buckwheat. Eastside elevation gradients tend to be more dramatic than on the westside, in many subalpine landscapes, leading to rapid changes in species composition and structure of eastside, high-elevation ecosystems.

The current composition and structure of subalpine and alpine ecosystems are mostly similar to desired conditions, with a few exceptions noted below (Meyer 2015c). Resilience is similar as well. The impacts of climate change will affect connectivity of subalpine forests, especially in the latter half of the 21st century. The following sections give more specific details for the two vegetation types.

Subalpine Woodlands and Forests

Subalpine vegetation occurs near the highest elevations of the plan area. Subalpine tree-dominated areas form woodlands when trees are sparse or low density. Most subalpine tree-dominated areas are woodlands. In other areas, trees are moderate to high density, more often in smaller patches. These areas comprise subalpine forests. The subalpine vegetation type typically occurs on shallow, less productive soils on most slope positions including ridgetops and steep slopes.

Current overstory and understory species composition is similar to the desired conditions. Current subalpine woodland and forest structure is also mostly similar to desired conditions, although there is a recent increase in the density of small-diameter subalpine trees and a decrease in the density of large-diameter trees. This has been attributed to climatic warming trends, which has increased favorable growing conditions in this harsh environment (Meyer 2015c; Safford, North, and Meyer 2012).

Resilience of subalpine woodlands and forests was high until recently but is undergoing rapid changes due to climate warming. Climate vulnerability of subalpine forests is among the highest of all vegetation types in the plan area (Meyer et al. 2014a; Safford, North, and Meyer 2012). Tree mortality rates associated with moisture stress and insects (especially mountain pine beetle) in subalpine forests dominated by high-elevation white pines is increasing at a rate that may soon exceed the desired conditions and natural range of variation. Resilience to fire is generally high (Meyer et al. 2014a). White pine blister rust may also increase in incidence within high elevation white pine stands on the Inyo National Forest (Maloney 2011).

Alpine Vegetation

Alpine vegetation occurs at the highest elevations of the plan area (greater than 10,000 feet elevation). This vegetation type typically occurs on very shallow, low productivity soils on most slope positions including ridgetops and steep slopes. Alpine vegetation in the plan area is dominated by perennial herbaceous plants (like Mason's sky pilot) or dwarf shrubs (such as white heather), but may also contain small, isolated subalpine tree islands and krummholz (stunted) whitebark pine stands. Shallow bedrock may dominate much of the cover in many alpine landscapes of the plan area.

Current species composition and structure of alpine vegetation is very similar to the desired conditions. Resilience is low to moderate. The vegetation in the alpine areas establishes and grows very slowly. Climate vulnerability of alpine vegetation is among the highest of all vegetation types in the plan area (Lenihan et al. 2008; Safford, North, and Meyer 2012), and some alpine plant and animal species have recently shifted their geographic ranges to higher elevations in the plan area (Kopp and Cleland 2014, Moritz and Stephens 2008, Moritz et al. 2008). With no other area to go to at higher elevations for cooler temperatures, these plants may decline in numbers or locations.

Eastside Shrublands and Woodlands

Eastside shrublands and woodlands dominate the lower elevation landscapes of the plan area. The primary vegetation types include sagebrush, pinyon-juniper, mountain mahogany (also occurs in Sierra Nevada montane and subalpine/alpine zones), and xeric shrub/blackbrush. These vegetation types occur in an area of convergence among three biogeographic provinces: the Sierra Nevada, Great Basin, and Mojave Desert. This area of convergence within the eastside shrublands and woodlands is characterized by high regional plant diversity, including relictual species, and an area of active expansion and contraction of species' geographic distributions (Slaton 2015). Changes in climate, and fire and grazing regimes in the late 19th and 20th centuries have been particularly important factors influencing the composition, structure and distribution of the different vegetation types within the plan area (Slaton and Stone 2015a, Slaton and Stone 2015b). These changes include an expansion of trees into open shrublands, and changes in vegetation successional patterns associated with modern livestock grazing and fire exclusion, although these patterns depend on several additional factors (such as vegetation type or climate). Invasive plants like cheatgrass and red brome have also significantly expanded their range in many arid shrublands and woodlands in recent years on the eastside of the plan area, especially in areas recently impacted by wildfires or inappropriate livestock grazing that can facilitate cheatgrass dispersal (Slaton and Stone 2015a and 2015b). In some cases this has led to type conversion from native shrub or woodland vegetation to nonnative grasslands, which includes the loss of native perennial grasses, native forbs, and biological soil crusts which are important for ecosystem integrity (Chambers et al. 2014). This rate of invasion is expected to continue or increase in the future, although projected changes in climate will alter the geographic distribution of these invasions in the later 21st century (Bradley 2009, Finch 2012).

Sagebrush

This vegetation type occurs in the Great Basin portions of the plan area, mostly the Inyo National Forest but also small portions of the eastern Sequoia National Forest. The distribution of different sagebrush species are strongly correlated to temperature and precipitation regimes. Dominant species include all subspecies of big sagebrush, low sagebrush, bitterbrush, and black sagebrush (Slaton and Stone 2015b). Big sagebrush and black sagebrush are generally restricted to moist and frigid soils, with low sagebrush occurring on some cryic (cold) soils.

The condition of sagebrush areas depends upon the location and environment. The current composition and structure of sagebrush on some more productive substrates are different from the desired conditions for this vegetation type. The composition and structure on less productive, harsher (colder, drier, shallow and rocky) soils is mostly similar to desired conditions.

The extent of sagebrush has decreased substantially. On the Inyo National Forest, an estimated 25,000 acres of sagebrush has had encroachment of several trees per acre or more (Slaton 2013). These areas were historically dominated by sagebrush but pinyon-juniper, and in some cases Jeffrey pine, have encroached into these shrublands due to a combination of fire suppression, livestock grazing, and climate change (Slaton and Stone 2015a). Projected changes in climate suggest that the geographic distribution of sagebrush will largely shift northward and to higher elevations due to increased summer moisture stress (Finch 2012). Resilience to invasion by pinyon and juniper or Jeffrey pine is low to moderate.

Overall, resilience of sagebrush is low to moderate depending upon the type of sagebrush, amount of nonnative annual grasses and proximity to risk factors for fire and nonnative grass invasion. Nonnative invasive plant species are increasing in number and extent in sagebrush, especially at lower elevations, in recently burned areas, and sites of inappropriate livestock grazing. Most notably the invasive annual grasses of cheatgrass and red brome have increased in the plan area. The map in figure 28 depicts the pattern of invasion of cheatgrass and red brome on the Inyo National Forest.

Information is combined from the Forest Inventory and Analysis plots and Terrestrial Ecological Unit Inventory plots and vegetation maps. This map does not represent a complete distribution of these invasive grasses but shows the extent of their invasion. Where these invasive grasses have been detected at survey plots, they are shown as red and orange dots and plots with no detections are shown as purple dots. Higher elevation sagebrush areas, with colder soils and moderate to high native perennial grass cover are more resilient. These areas are more likely to resist type conversion to annual grasses, including after fire (Chambers et al. 2007).

In the eastside vegetation types, there are large sagebrush and pinyon-juniper areas that have decreased fire resilience because of nonnative annual grasses (such as cheatgrass and red brome) that make them susceptible to more frequent fires that disrupt native vegetation composition and structure (Chambers et al. 2014). For example, post-fire vegetation recovery in sagebrush ecosystems invaded by cheatgrass can result in the conversion of sagebrush vegetation to nonnative annual grassland, especially in the presence of other stressors, such as inappropriate livestock grazing, climate change and overgrazing by wild horses (Chambers et al. 2007, Chambers et al. 2014).

Pinyon-juniper

Pinyon-juniper is extensive in the plan area, mostly on the Inyo National Forest. This vegetation type dominates mid-elevations on the eastside plan area, especially on the east slope of the Sierra Nevada, Great Basin, Mojave Desert, and portions of the Kern Plateau. Pinyon-juniper is dominated by single leaf pinyon and Utah juniper, although many stands in the plan area are dominated exclusively by single leaf pinyon (Slaton and Stone 2013a). Pinyon-juniper types may also be mixed with or located in close proximity to sagebrush, mountain mahogany, and xeric shrublands.

The condition of structure in pinyon-juniper compared to desired conditions varies with location and environment. Where pinyon-juniper grows on harsher sites (steep rocky slopes and ridges or sites with shallow and rocky soils), structure is generally similar to desired conditions (Slaton and Stone 2015a). On more productive sites, structure of pinyon-juniper is moderately dissimilar to desired conditions. Tree density is higher.

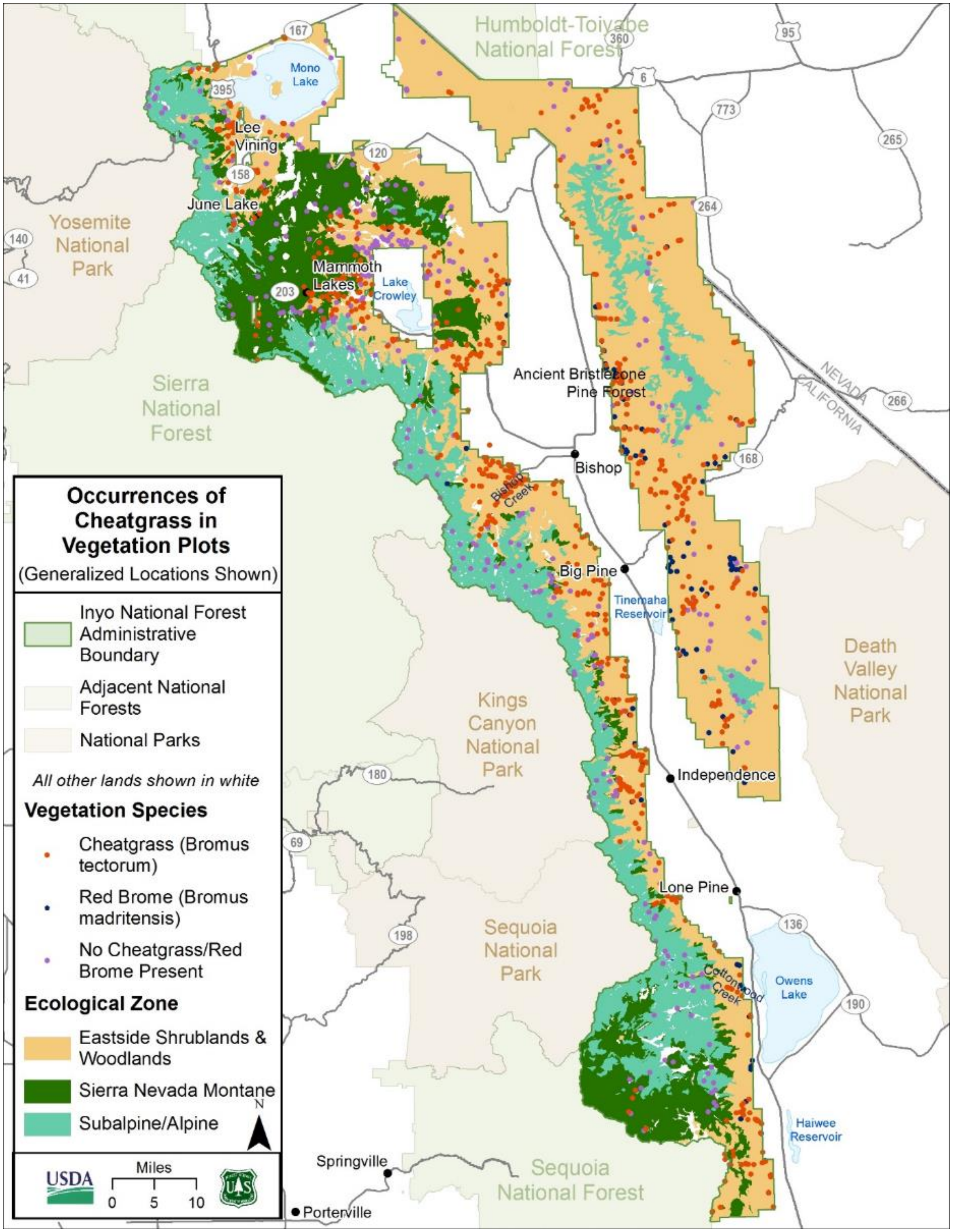

Figure 28. Occurrences of cheatgrass in vegetation plots, Inyo National Forest

Resilience also varies with location and environment. On the harsher sites, the vegetation is generally resilient because the structure has remained more open and there is low understory vegetation cover. On the more productive sites, resilience is low to moderate. Higher tree density, accumulated fuels around the base of the trees, and higher and more decadent shrub, grass, and herb cover result in higher intensity fire and less resilience to drought, insects, and pathogens. There have been elevated levels of tree mortality in pinyon-juniper (see “Insects and Pathogen” section). Pinyon-juniper ecosystems invaded by cheatgrass have reduced ecological integrity and are prone to type conversion to nonnative grasslands, particularly in areas of inappropriate livestock grazing, uncharacteristic wildfires (fires burning too frequently), and other stressors (such as high vulnerability to climate change) (Miller, Chambers, and Pellant 2014; Miller et al. 2014).

Mountain Mahogany

Mountain mahogany occurs in the eastside shrublands and woodlands but can also occur at higher elevations in the Sierra Nevada montane zone or subalpine and alpine zone (Slaton 2013). This vegetation type generally occurs on steep, rocky, and variable terrain and is frequently mixed with other types, such as Jeffrey pine forest, pinyon-juniper, and sagebrush. The current composition, structure, and resilience of mountain mahogany vegetation is broadly similar to the desired conditions and natural range of variation in the plan area. However, mineral development, roads, and dispersed recreation may be negatively impacting this vegetation type at localized scales. Here there have been changes to composition, structure and spatial pattern. In these localized areas, there has been a decrease in native plants and an increase in nonnative annual grasses. The primary change has been increased fragmentation in small areas.

Xeric Shrub-Blackbrush

Xeric shrub and blackbrush occupies the lowest elevations of the plan area. This type is dominated by one or more desert shrub species, including but not limited to blackbrush, saltbush, goldenbush, and horsebrush.

The current composition, structure, and function of most xeric shrub and blackbrush ecosystems are consistent with the desired conditions for this vegetation type. However, portions of these arid shrublands have been negatively impacted by too-frequent fire (post-fire recovery of blackbrush is typically more than 50 to 75 years; (Brooks and Minnich 2006), mining, off-highway vehicle activity, livestock grazing, and invasive plants. In particular, nonnative annual grasses, red brome and cheatgrass, are increasing in frequency in many xeric shrub and blackbrush communities. There is a corresponding decrease in native plants, away from the desired conditions. The increase in nonnative annual grasses decreases resilience to fire dramatically. Nonnative grasses increase the likelihood of fire, which is naturally rare in these sparsely vegetated areas. Projected changes in climate suggest that some xeric shrub ecosystems will expand in the plan area in the coming decades, and Mojave Desert associated species (such as creosote bush and Joshua tree) will shift northward into the lower elevations of the Great Basin (Finch 2012).

Environmental Consequences to Vegetation Composition, Structure, and Resilience

This analysis focuses on vegetation types most departed from the natural range of variation and vegetation desired conditions as described in the revised forest plan. These vegetation types are also the focus of restoration actions (mechanical and prescribed fire treatments and managing wildfire to meet resource objectives) and where the greatest potential consequences will occur. This includes mixed conifer, eastside Jeffrey pine, pinyon-juniper, and sagebrush vegetation types. There will be some increased emphasis on restoration actions in red fir and lodgepole pine forests in some alternatives and on the eastside around developed areas. There will be some management of chaparral near developed areas. For other vegetation types, there will likely be little management activity and as a result, little to no expected consequences. This includes subalpine, alpine, desert (xeric shrub/blackbrush) and mountain mahogany vegetation types.

Consequences Common to all Alternatives

Alternatives B, C, and D share most of the same vegetation desired condition plan components (table 26). The differences are in some of the overlapping desired conditions for some wide-ranging wildlife species. Below is a discussion of the general nature and environmental consequences of the large number of shared vegetation desired conditions.

Table 26. Revised forest plan desired conditions for vegetation across all vegetation types

Vegetation Function	Desired Conditions[1]
Mosaic providing ecosystem integrity and diversity. Provides habitat for native and desirable nonnative plant and animal species.	TERR-FW-DC-01, 06; SPEC-FW-DC-01
Resilience to climate change, drought, insects and pathogens	TERR-FW-DC-02, 03. 04
Conditions contribute to recovery and persistence of threatened and endangered species and species of conservation concern	TERR-FW-DC-05; SPEC-FW-DC-02, 03
Provides landscape connectivity for wide-ranging habitat generalist (deer) and habitat specialist (old forest and sagebrush) species	TERR-FW-DC-06; TERR-OLD-DC-02 SPEC-SG-DC-04;
Carbon carrying capacity is stable or improving	TERR-FW-DC-07
Fire occurs within ecologically appropriate regime and enhances ecosystem heterogeneity, habitat and species diversity. Vegetation conditions help reduce the threat of undesirable wildfires to local communities, ecosystems and scenic character.	TERR-FW-DC-08,09
Landscape sustainability provides a variety of benefits to people	TERR-FW-DC-10
Vegetation supports continued use by tribes	TERR-FW-DC-11

1. Specific desired conditions are referenced in the Land Management Plan for the Inyo National Forest

The vegetation desired conditions for these alternatives are specific to each major vegetation type and include desired ranges and often median levels of seral stages and canopy cover, basal area, snags, and large tree densities (table 27).

Table 27. Revised forest plan desired conditions by ecological zone and major vegetation types

Ecological Zone	Vegetation Types	Desired Conditions
Sierra Nevada Montane	Dry Mixed Conifer, Jeffrey Pine, Red Fir, Lodgepole Pine (wet and dry types)	TERR-MONT-DC 01-03; TERR-DMC-DC 01-06; TERR-RFIR-DC 01-07; TERR-JEFF-DC 01-07; TERR-LDGP-DC 01-10;
Subalpine and Alpine	Subalpine conifer, Alpine vegetation	TERR-ALPN-DC 01-05
Eastside Shrublands and Woodlands	Sagebrush, Pinyon Juniper, Mountain Mahogany, Xeric Shrub/Blackbrush	TERR-SAGE-DC 01-05; TERR-PINY-DC 01-05; SPEC-SG-DC-02, 05, 08; TERR-XER-DC-01-04

These are based on a combination of best available scientific information that reflects the natural range of variation (Safford et al. 2013c, Meyer et al. 2014b, Slaton and Stone 2015b) and habitat requirements for wide-ranging federally listed species or species of conservation concern (greater sage-grouse; see Vegetation Desired Condition supplementary report). There are more general desired conditions that are important, but there is no specific best scientific information to base them on. This includes forest heterogeneity (North, Stine, O'Hara et al. 2009; North 2012b).

For purposes of this analysis, it is assumed that when vegetation treatments move vegetation toward the vegetation desired conditions, the vegetation moves toward the natural range of variation and has associated benefits of moving toward ecological integrity and sustainability. The landscape amount and intensity of the treatments affect how much the vegetation moves toward desired conditions. Low-intensity treatments, where little area is treated or slight changes are made, would have a slight improvement in vegetation conditions (Schmidt, Hille, and Stephens 2006; Stephens et al. 2015). When more area is treated, particularly at the landscape scale, there is a greater positive impact on ecological integrity and sustainability. For example, in the “Fire Trends” section, the effect of restoring between 40 and 60 percent of the landscape was sufficient to result in reduced trends in large fires and associated large, high-severity patches that are considered outside the natural range of variation (van Wagtendonk and Fites-Kaufman 2006, Collins and Skinner 2014a, Stephens et al. 2015).

The same treatment means are available across each of the alternatives but will be used to varying degrees. Treatments would include mechanical thinning (various prescriptions, understory, varied diameter), salvage, mastication, prescribed fire (small and landscape, by itself or with mechanical treatment) and wildfire managed for resource objectives. The environmental consequences depend upon the extent and intensity of the treatment, and the vegetation type it is applied in. Below is a brief description of the array of restoration treatments that will be used and a summary of the overall consequences for the major vegetation types they will be applied to. This includes the more recent and relevant best available scientific information. A more detailed discussion of the best available science is found in the Vegetation Ecology supplemental report.

Sierra Nevada Montane Zone

Mechanical Treatments: Mechanical restoration treatments in the montane zone can be highly effective at restoring forest structural features (canopy cover, tree density, heterogeneity) and overstory tree species composition in montane forests (Larson, Stover, and Keyes 2012; North 2012b and 2014; North, Innes, and Zald 2007; North, Stine, O'Hara, et al. 2009). However, the type and intensity of treatment can result in varying levels of change in forest structure. Additionally, mechanical treatments may be effective at achieving some restoration objectives (such as restoration of tree species composition), but these treatments are often less effective than fire treatments (prescribed fire or wildfires managed for resource objectives) for the restoration of structural heterogeneity and key ecological processes (such as nutrient cycling, plant-pollinator interactions, or soil respiration).

In long-term monitoring plots on Forest Service study sites in California, both overstory and pole-sized tree densities were effectively reduced following mechanical treatment but fuel levels increased 8 years following treatment due to vegetation re-growth and dead fuel accumulation (Vaillant et al. 2015). Similarly, research fuel treatment plots also resulted in decreases in tree density (Stephens and Moghaddas 2005). There are two types of thinning that would occur in alternatives B, C, and D. One is thinning from below where smaller diameter trees are removed. The second is variable diameter thinning where smaller diameter understory trees and some larger diameter midstory or overstory trees are removed. There is no specific research to compare the effects of these two approaches on moving vegetation toward the desired conditions. However, in many stands that have densities exceeding the desired conditions, thinning from below will remove fewer trees and have a limited effect of moving stands toward desired conditions for canopy cover, basal area, or heterogeneity.

Prescribed Fire and Wildfire Managed for Resource Objectives: Prescribed fire can restore understory species composition (Wayman and North 2007, Webster and Halpern 2010), and reduce tree density (Stephens and Moghaddas 2005, Vaillant et al. 2015). The amount of reduction in overstory tree density depends on the intensity and size of the fire. Low-intensity fires have little to no effect on overstory tree density and composition, but moderate-intensity fire has been found to reduce forest density by up to 70 percent and basal area by 20 percent (Schmidt, Hille, and Stephens 2006). There is little research on the effects of prescribed fire on heterogeneity, but the prevailing view is that prescribed fire can increase heterogeneity if it is incorporated into the burn prescription (Collins and Skinner 2014a), especially if it is moderate intensity (Schmidt, Hille, and Stephens 2006). Larger landscape prescribed fire or wildfire managed for resource objectives are likely to restore heterogeneity at multiple spatial scales (Collins, Everett, and Stephens 2011, Kane et al. 2013, Kane et al. 2014, Meyer 2015a). This may be due in part to more varying fire intensity with larger burn areas, across a wider range of conditions (burning day and night, on different days). Wilderness areas are especially conducive towards the management of wildfires for resource objectives, which supports ecological benefits in wilderness areas of the southern Sierra Nevada (Meyer 2015a) and elsewhere in the western United States (Miller and Aplet 2016). Additionally, wilderness areas with restored natural fire regimes can provide important reference sites that inform wildland fire science and the natural range of variation in montane forest ecosystems (Miller and Aplet 2016).

Mechanical and Prescribed Fire Treatments: Many studies show that the combination of mechanical thinning and prescribed or wildfire managed to meet resource objectives are the most effective in reducing vegetation density, restoring understory and overstory composition, and increasing heterogeneity (North, Innes, and Zald 2007, Collins, Moghaddas, and Stephens 2007, Collins and Skinner 2014a). This is especially the case for understory composition. Many plants in the analysis area in areas that had frequent fire historically, are fire adapted (Fites-Kaufman, Bradley, and Merrill 2006, van Wagtendonk and Fites-Kaufman 2006).

The longevity of restoration treatments depends largely on the growth rates of the plants that have been affected by the treatments. For understory trees and shrubs, reduced density only lasts 8 to 15 years because they grow back rapidly (Stephens, Collins, and Roller 2012, Chiono et al. 2012), and (Vaillant et al. 2015). On the other hand, fire-induced reductions in tree density took up to 8 years to be realized in one prescribed fire study (Van Mantgem et al. 2011).

The best information pertaining to the effectiveness of mechanical treatments at restoring structural heterogeneity in Sierra Nevada mixed conifer stands comes from research conducted at the Teakettle Experimental Forest and Stanislaus-Tuolumne Experimental Forest. Understory and variable-density thinning in mixed conifer stands at these experimental forests resulted in reduced stem density and a residual spatial tree pattern that was closest to historic conditions (that is, reduced tree clustering at smaller spatial scales); although surface fuel loading was not reduced relative to stands not thinned (North, Innes, and Zald 2007, Knapp et al. 2017). Consequently, understory thinning (and especially variable density thinning) increased structural heterogeneity at smaller spatial scales. At the Teakettle and Stanislaus-Tuolumne Experimental Forests, prescribed burning decreased mixed conifer stand densities, reduced surface fuel loading, and increased stand heterogeneity but had marginal effect on canopy cover. In contrast, mixed conifer stands treated with a combination of mechanical thinning followed by prescribed burning had substantially lower densities and canopy cover (closer to the historic conditions or the natural range of variation), reduced fuel loading, and greater stand heterogeneity than untreated stands or those treated with prescribed burning or mechanical thinning alone (North, Innes, and Zald 2007, Knapp et al. 2017). Consequently, post-treatment stand structure in the combined understory-thin and burn treatment was closer to the historic conditions and resulted in generally greater stand structural heterogeneity than found in stands treated with a single restoration treatment (mechanical thinning or prescribed burning alone). The combination of mechanical and prescribed fire treatments were most effective at restoring stand structure, but only in cases where the mechanical treatments retained the largest-diameter trees in the stand (North, Innes, and Zald 2007, North, Stine, O'Hara, et al. 2009) and where thinning prescriptions emphasized variable density thinning to enhance structural heterogeneity (Knapp et al. 2017).

In red fir forests, low severity fire is especially conducive to increasing forest structural heterogeneity at multiple spatial scales (Kane et al. 2013). In addition, surface fuel loading tended to be two times higher in unburned than twice-burned red fir stands of Yosemite National Park, with high variation in fuel loading among burned and unburned sites. Both prescribed fire and wildlife managed for resource objectives (especially low to moderate severity fire) are highly effective at restoring stand structure (e.g., tree densities, basal area, canopy cover, heterogeneity) and understory diversity in red fir forests (Meyer et al. 2010).

Eastside Shrublands and Woodlands

Mechanical and Prescribed Fire Treatments: There are two general purposes for treatments that will occur in eastside shrublands and woodlands, especially sagebrush and pinyon-juniper woodlands. First, treatments can focus on reducing fire hazard around communities and infrastructure using treatments such as mechanical mowing or crushing. Second, treatments may focus on sagebrush restoration by reducing the density of encroaching conifers in sagebrush habitat (i.e., mechanical thinning), which often includes the treatment of slash (can vary from removal, to piling or scattering). Restoration treatments in sagebrush may also focus on enhancing structural heterogeneity, age and size diversity, and understory diversity in sagebrush areas by reducing the density of large and dense shrub patches.

Woody vegetation reduction by any means, either prescribed fire or burning can result in higher herbaceous cover (McIver et al. 2014). Where slash is removed there can be benefits to plant species richness and diversity (Brockway et al. 2002). Prescribed fire can be effective at removing woody vegetation but may result in a greater risk of invasion by nonnative annual plants (Chambers et al. 2014, Miller et al. 2014) (Pyke et al. 2014). Mechanical treatments can more directly target individual trees that are desired to be removed but also can lead to increased nonnative plant invasion, especially in areas of inappropriate livestock grazing or Off-Highway Vehicle (OHV) use (Chambers et al. 2014, Miller et al. 2014, Pyke et al. 2014). However, the use of targeted nonnative plant treatments (e.g., control or eradication of invasive annual grasses such as cheatgrass) or seeding with native perennial bunchgrasses and forbs in combination with mechanical thinning and prescribed fire treatments may reduce the long-term abundance or occurrence of some nonnative plants, especially in cooler and moister sites (Chambers et al. 2014; Miller, Chambers, and Pellant 2014; Pyke et al. 2014).

Treatment of shrub vegetation with mowing and prescribed fire have varying effects on the understory but different effects on the shrub layer. Some researchers found increases in native herbaceous and perennial grass species with prescribed fire or mowing (Bourne and Bunting 2011, Chambers et al. 2014, Miller et al. 2014, McIver et al. 2014), whereas others found decreases (Pyke et al. 2014). Shrub cover responses varied with decreases reported after prescribed fire (Roundy et al. 2014) or mowing (Bourne and Bunting 2011). In some cases, shrub cover decreased for the first year (Bourne and Bunting 2011) but then cover and seedling density rebounded or increased by year three (Miller et al. 2014) summarized the shrub changes in terms of greater sage-grouse habitat and reported an increase of three times in shrub cover for prescribed fire and two times pre-treatment levels for mechanical treatments.

Mechanical treatments in eastside pinyon-juniper and sagebrush ecosystems may include the cutting and falling of encroaching conifers, followed by the piling or scattering of slash or removal of slash offsite. Mastication treatments can be applied to mow and mulch shrubs and small trees. Slash may be chipped to alter and redistribute surface fuels. Conifer removal and mastication treatments are generally effective at restoring ecosystem structure and are considered low to moderate intensity methods with less impact on biological soil crusts and invasive species spread than high-intensity mechanical methods (such as chaining, bulldozing, or plowing; Chambers et al. 2014, Miller et al. 2014). Mechanical treatments of encroached conifers in sagebrush ecosystems generally result in increased native herbaceous plant cover and diversity (including native forbs and perennial grasses), increased native shrub abundance, reduced canopy and ladder fuel loading, and increased fine surface fuel loading (Roundy et al. 2014). Mechanical treatments are most effective in promoting native herbaceous plant and sagebrush cover and inhibiting cheatgrass cover with the application of post-treatment management approaches, such as delayed grazing coupled with post-treatment monitoring (Chambers et al. 2014, Miller et al. 2014). Cheatgrass abundance may actually increase following mechanical treatments in the absence of these post-treatment measures (Chambers et al. 2007; Miller, Chambers, and Pellant 2014).

Prescribed fire is often applied in pinyon-juniper and sagebrush ecosystems to restore ecosystem structure and composition (Chambers et al. 2014; Miller et al. 2014; Miller, Chambers, and Pellant 2014). Applied alone or in combination with mechanical treatments, prescribed fire can be effective at reducing the densities of encroaching conifers, increasing sagebrush seedling density, increasing native forb and grass cover, reducing ladder and surface fuel loading, and decreasing overall biomass (Miller et al. 2012, Rau et al. 2010). Prescribed fire is particularly effective at restoring ecosystem composition and mitigating cheatgrass invisibility within sagebrush ecosystems with relatively high ecological integrity (in the early to mid-phase of pinyon or juniper expansion (Chambers et al. 2014). In contrast, the application of prescribed fire can exacerbate cheatgrass invisibility in sagebrush ecosystems lacking sufficient pre-fire cover or seed banks of residual native grasses and forbs (as in the late-phase of pinyon or juniper invasion; (Jones et al. 2015, Miller, Chambers, and Pellant 2014). Additionally, prescribed fire (especially at higher burn intensities) can reduce the abundance of biological soil crusts (Miller, Chambers, and Pellant 2014), which reduces the resistance of sagebrush ecosystems to cheatgrass invasion (Chambers et al. 2007). However, proper pre-fire fuel mitigation such as mechanical treatments and post-fire management (like grazing management) may help reduce some of the impacts of prescribed fire to biological soil crusts (Miller et al. 2014).

Invasive Plant Treatments All Areas

Alternatives B, B-modified, C, and D include similar measures to mitigate the invasion and spread of nonnative species such as risk assessment and rapid identification and control where possible.

Ecological Fire Resilience

Ecological fire resilience is most important at the landscape scale. Individual small patches of high fire severity are within the natural range of variation (van Wagtendonk and Fites-Kaufman 2006). The consequences of large areas of high severity and proportions exceeding the natural range of variation are important. To analyze these consequences, ecological fire resilience was analyzed using “benchmark” or generalized landscape restoration levels of 15, 30, 60 and 100 percent of the landscape (see “Fire Trends” section, scenario modeling discussion). The specific locations of restoration treatments are not identified in the draft programmatic plans or alternatives. These results were used to make inferences on the consequences of the different levels and spatial patterns of restoration among the alternatives. See discussion in the “Fire Trends” section for more detail on the effects of landscape changes in vegetation and effects on fire and potential for large, high-intensity fires.

The changes in ecological fire resilience for the scenarios are shown in figure 29. For the primary forest types where restoration would occur (mixed conifer, red fir, and Jeffrey pine) high resilience is where less than 25 percent of the area would burn as crown fire. Low resilience is where more than 75 percent of these areas would burn as crown fire. While the scenarios were not developed specifically for the alternatives, alternative A would be most similar to the current condition or 15 percent restoration scenarios, alternatives B and alternative B-modified would be most similar to the 15 percent or 30 percent scenarios, alternative C would be similar to the 15 percent scenario, and alternative D would be most similar to the 30 percent to 60 percent scenarios.

Comparison of Composition and Structure by Alternative

Table 28 through table 31 show how similar vegetation composition and structure would be to desired conditions by ecological zone and vegetation type for each alternative. Table 28 and table 29 show the Sierra Nevada montane zone, table 30 shows eastside shrublands and woodlands, and table 31 shows the Kern River drainage. This area is intermediate between westside and eastside vegetation. A discussion of the consequences by alternative follows. For table 28 through table 31, see Table 24 for a description of low, moderate, and high ratings.

Table 28. Similarity to vegetation composition and structure desired conditions for Sierra Nevada montane zone by alternative

Characteristic	Alternative A	Alternatives B and B-modified	Alternative C	Alternative D
Composition	Low (limited restoration)	Low-moderate ; moderate in areas of increased restoration and managed fire	Low (limited restoration); sight increase over A	Somewhat greater than B (more restoration)
Composition (Invasive plants)	Moderate	Moderate, slightly greater than A	Moderate	Slightly less than B
Structure	Low (limited restoration)	Low to moderate; Somewhat greater than A	Low (limited restoration); slight increase over A	Somewhat greater than B (more restoration)

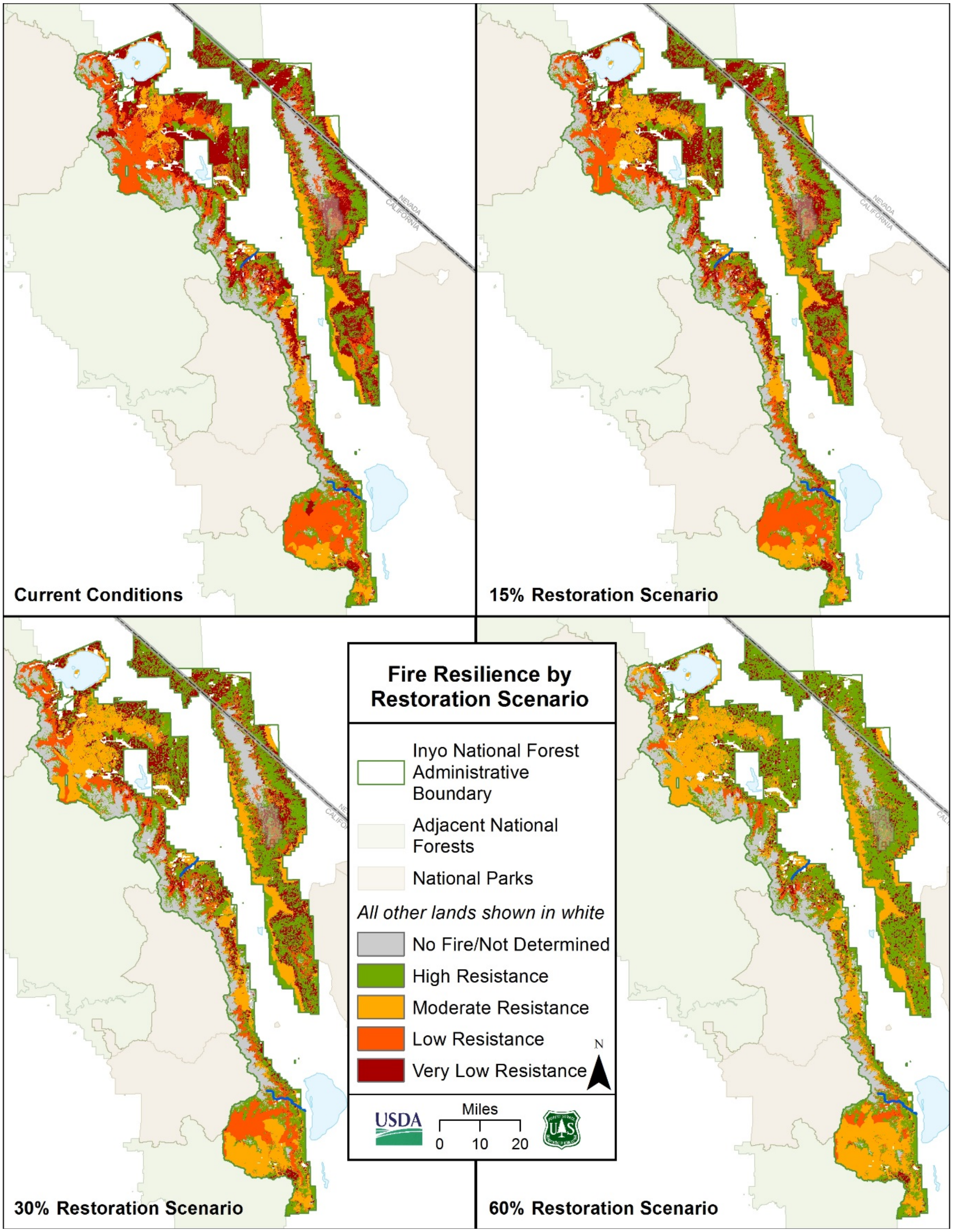

Figure 29. Landscape ecological fire resilience by restoration scenarios

Note: Areas in dark red are very low resilience, orange are low resilience, yellow is moderate resilience, and green is high resilience.

Table 29. Similarity to vegetation composition and structure desired conditions for Sierra Nevada montane zone by alternative and location relative to the fire protection zones

Characteristic	Inside fire protection zones,	Inside fire protection zones	Outside fire protection zones	Outside fire protection zones
Composition	Low-moderate (limited restoration, slightly greater than A)	Moderate	Low to moderate	Low, similar to A
Composition (Invasive Plants)	Low (limited restoration, slightly greater than A)	Low to moderate	Low to moderate	Low, similar to A
Structure	Low (limited restoration, slightly greater than A)	Moderate	Low to moderate	Low, similar to A

Table 30. Similarity to vegetation composition and structure desired conditions for eastside shrublands and woodlands zone by alternative

Characteristic	Alternative A	Alternative B and Alternative B-modified	Alternative C	Alternative D
Composition	Low (limited restoration)	Low to moderate (restoration areas)	Same as B (same as D in sagebrush)	More than B (more restoration)
Composition (Invasive plants)	Low to moderate (low in low elevations)	Slight increase from A (restoration areas)	Slight increase in similarity to desired conditions from A (restoration areas)	Less similarity to desired condition as compared to B (and similar to A)
Structure	Low (limited restoration)	Low to moderate (restoration areas)	Moderate (more similar to desired conditions because more treatments in sagebrush)	More than B (more restoration)

Table 31. Similarity to vegetation composition and structure desired conditions for the Kern River Drainage by alternative

Characteristic	Alternative A	Alternative B and Alternative B-modified	Alternative C	Alternative D
Composition	Low (limited restoration)	Low to moderate (restoration areas)	Same as B	More than B (more restoration)
Composition (Invasive plants)	Low to moderate (low in low elevations)	Slight increase from A (restoration areas)	Slight increase in similarity to desired conditions from A (restoration areas)	Less similarity to desired conditions as compared to B (and similar to A)
Structure	Low (limited restoration)	Low-moderate (restoration areas)	Less than B	More than B (more restoration)

Consequences Specific to Alternative A

Although the current plan aspires to treat 20 to 30 percent of the forest to reduce fuels, this has not been achieved. It is estimated that 5 to 10 percent of the Sierra Nevada montane zone and eastside sagebrush and pinyon-juniper areas have been treated since 2001. Most of the treatment would occur in the sagebrush, pinyon-juniper and wildland-urban intermix area on the east side.

Sierra Nevada Montane Zone

Overall treatment rates are limited in alternative A. Generally, less than 5 to 10 percent of the landscape has been restored over the last 10 years. The treatments in these forest types are usually low intensity due to restrictions on the amount of canopy cover that can be reduced and, more importantly, the lack of mill infrastructure within a reasonable distance to the Inyo National Forest. As a result, composition, structure, and resilience would remain dissimilar to vegetation desired conditions.

Composition. There would continue to be a high proportion of shade-tolerant and fire-intolerant trees in the overstory and understory. Within dry mixed conifer and some Jeffrey pine stands, there would be limited opportunities to restore dominance or codominance of Jeffrey pine due primarily to the proximity to mills but, even if the infrastructure existed within a reasonable distance, diameter limits would restrict removal of competing shade-tolerant species that have grown quickly during a century of fire suppression. For the same reasons, there would be little opportunity to create sunny openings of sufficient size for Jeffrey pine regeneration. Treatments or managed fire would retain desired overstory composition for red fir and lodgepole pine stands. However, limited amounts of prescribed fire would result in little restoration of understory plants that are adapted to fire.

Structure. There could be restoration to increase heterogeneity, but restrictions on changing canopy cover and proximity to mills limit how much change would occur. While treatments primarily reduce understory trees, there would continue to be a high dissimilarity to vegetation desired conditions in most of the landscape.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. The low proportion of the landscape that would be restored and the low intensity of treatments make it highly likely most of the area would continue to have a low resilience to drought, climate change, insects, pathogens, and large, high-intensity fire.

Montane Forests (Kern River Drainage)

There would continue to be limited mechanical treatment and prescribed fire restoration in montane forests of the Kern River Drainage in alternative A. There would be some wildfire managed to meet resource objectives, especially in the Kern River drainage and some wilderness areas. These managed fires would generally move montane forests toward vegetation desired conditions. Composition, structure and resilience of montane chaparral and Jeffrey pine forests would benefit from fire.

Composition. Restoration treatments would move understory tree composition toward desired conditions in Jeffrey pine forests. Shade- and fire-intolerant white fir would be removed up to the diameter limit. Mechanical treatments and fire would have a similar beneficial effect. There would be little change in composition of red fir forests and lodgepole pine forests because they tend to be the dominant species, with or without restoration. Understory composition would continue to improve with restoration, especially where it includes fire (Wayman and North 2007). Where wildfire is managed to meet resource objectives, it would improve montane chaparral composition. Many of these species in montane chaparral are adapted to fire.

Structure. Restoration treatments would move some areas slightly toward desired conditions and others substantially. There would be limited ability to reduce forest density and most importantly in the montane forests, increase heterogeneity. Where large areas have wildfire managed to meet resource objectives there would be increased heterogeneity and a decreased vegetation density.

Chaparral would have more of a mosaic of age structure. Jeffrey pine and red fir forests would have increased heterogeneity, reduced and patchier surface fuels and increased resilience.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. Restoration treatments would continue to be at a very low level, except for more remote areas (like the Kern River drainage and wilderness areas) that have had and will likely continue to have wildfire managed to meet resource objectives. The more remote areas have a moderate level of resilience and the Kern River drainage would likely increase to a high level of resilience over the period of the plan. The other areas would likely remain at a low level of resilience.

Subalpine and Alpine Zone

There is little direct management vegetation in the subalpine and alpine zone in alternative A. Most of this vegetation is in wilderness areas, where natural processes are the dominant management approach. Exceptions are in limited locations where recreation use is concentrated.

Composition. Alternative A would continue to minimize the spread of invasive plants in subalpine and alpine environments where restoration treatment activities are supported (like ski areas).

Structure and Resilience. Subalpine and alpine vegetation are among the most vulnerable to climate change (Meyer et al. 2014b, Sydoriak et al. 2013b). Management in the remote areas, mostly wilderness where these vegetation types occur, would continue to be very limited. With changing climate, in the absence of restoration, mortality of some subalpine trees (like whitebark pine) would continue to increase.

Eastside Shrublands and Woodlands (excluding Sagebrush)

Treatments in pinyon-juniper and arid shrublands are limited in alternative A. Most of it would continue to occur in the wildland-urban intermix defense and threat zones.

Composition. There would be limited opportunities to reduce or eradicate nonnative invasive plants. These areas would continue to remain dissimilar to desired conditions for understory species composition. Targeted treatments to reduce or eradicate nonnative invasive plants would continue to occur. However, there would likely continue to be an increase in the area occupied by nonnative invasive plants.

Structure. Limited restoration would leave many areas with higher pinyon and juniper density where they exceed desired conditions. This is only a portion of the pinyon and juniper vegetation. Areas on very harsh sites would remain similar to desired conditions.

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would continue to be large areas that are dissimilar to desired conditions and have high levels of insect-related mortality. Current trends of elevated insect and drought-related mortality are likely to increase. There would continue to be areas with low resilience to drought, climate change, insects and pathogens, and large, high-intensity fire.

Eastside Shrublands and Woodlands: Sagebrush

Restoration of sagebrush habitats would continue to implement the “Sage-Grouse Interim Management Policy” for greater sage-grouse; however, there is the least amount of restoration in sagebrush vegetation in alternative A. Restoration of composition and structure would be limited to small areas and a very small proportion of the extent that this vegetation type occurs.

Composition. There would be limited areas that will move vegetation toward desired conditions. There would be fewer opportunities to remove conifers encroaching in sagebrush vegetation. Alternative A would continue to minimize the spread of invasive plants in arid shrublands and woodlands because there would be fewer restoration treatments.

Structure. There would continue to be many areas that are dissimilar to desired conditions for a mosaic of ages of sagebrush. There would continue to be large areas where many of the shrubs are older and decadent (lack new growth).

Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. There would continue to be a low resilience to large, high-intensity fire and climate change. Low structural diversity and limited reduction of invasive plants would make it likely that resilience will decline further. There would continue to be a high dissimilarity to desired conditions.

Cumulative Effects of Alternative A

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be more prominent than the restoration benefits because of the low amount, small scale, and limited intensity of restoration in alternative A (see “Climate” section). There would continue to be restoration on adjacent Federal, State and local agency lands (such as Los Angeles Department of Water and Power) that are similar to those on National Forest System lands. Restoration on these other lands would also be limited. There would continue to be urbanized development adjacent to national forest lands and increased recreational visitor use. There would likely be related increases in human-ignited fires and spread of invasive plants as a result of the combination of increased human presence and climate change. The size and area of large, high-intensity fires would continue to increase (see “Fire Trends” section). Overall, vegetation composition, structure, and resilience would become more dissimilar to desired conditions.

Consequences Specific to Alternative B

In these alternatives, plan direction for vegetation management would change desired conditions, objectives, standards and guides, management approaches, and goals that would affect vegetation composition, structure and resilience. The degree of change varies by vegetation type and location. The most overarching changes are described here and the remainder in specific vegetation types and locations as relevant.

All Areas

Throughout all of the analysis area, there are two fire-related management areas that have different vegetation-related plan direction and each would have different impacts. They are the strategic fire management zones and the community buffers.

Community buffers are linear areas surrounding communities and, on the Inyo National Forest, they surround developed recreation sites at high fire risk. The widths are based on expected fire behavior. The desired conditions for vegetation may be different in the community protection zone, with lower canopy cover, snag densities, log densities, and surface fuels (MA-CWPZ-GDL-01). Otherwise, management direction for fire-oriented treatments is consistent with desired conditions for terrestrial vegetation (MA-CWPZ-GDL-02).

There are several differences in plan components in the two wildfire protection zones compared to the other strategic fire management zones that would affect the mix and intensity of vegetation treatments and thus vegetation consequences. The direction on large-diameter trees differs as shown in table 32.

Table 32. Application of large tree plan components across strategic fire management zones, alternatives B and B-modified

Plan Direction	Inside Wildfire Protection Zones	Outside Wildfire Protection Zones
TERR-FW-STD-01 (30-inch diameter limit)	Does not apply	Applies, same as alternative A
TERR-OLD-DC-04 (desired densities of large trees by forest type)	Applies	Applies

Although there are desired conditions for old forest, in the two wildfire protection zones there are no diameter limits on large trees that can be removed mechanically. This may result in more intensive thinning in some areas, but how much is unknown. Outside of the two wildfire protection zones, the standard restricting removal of 30-inch diameter trees is retained (TERR-FW-STD-01). This may have consequences for old forests and is discussed in the following subsection on “Terrestrial Ecosystem Processes and Function.” There would also be more use of wildfire managed to meet resource objectives, primarily outside of the wildfire protection zones. This would result in more restoration of vegetation using this treatment. This would most likely occur in Sierra Nevada montane zone and subalpine vegetation type.

Treatments would primarily be variable density mechanical thinning and burning to restore heterogeneity, decrease overall forest density, decrease surface fuel continuity, and increase understory cover, density, and vigor, particularly of sun-loving plants. The approach would be as described in GTR 220 and 237 (North, Stine, O'Hara et al. 2009; North 2012b), emphasizing restoration of heterogeneity. There would be variable spacing in thinning and burning. Some areas would be thinned more and some areas less or not at all. Thinning could occur across a range of diameters, between small- to medium-diameter trees. Some small openings would be created while clumps of trees would be retained in some areas. There would be retention and creation of heterogeneity in the understory as well, as described in the desired conditions. Some patches of high surface fuel would occur, and other areas would have little to none.

Sierra Nevada Montane Zone

Alternative B would increase the amount of vegetation restoration in the Sierra Nevada montane zone. Although wildfires managed to meet resource objectives has occurred extensively in the Kern Drainage, the new plan direction that provides for managing wildfires to meet resource objectives would make this more likely to continue to occur or increase (MA-WRZ-GOAL-01, MA-WRZ-STD-01, MA-WMZ-DC-02, and MA-WMZ-STD-01 to 02).

The amount of prescribed fire and wildfire managed to meet resource objectives could increase in alternative B (TERR-FW-OBJ-02; TERR-FW-DC-08; TERR-MONT-DC-02), although there are some uncertainties about the amount of increase. The amount could double that in alternative A. Larger prescribed fires would be more feasible because the prioritized restoration along ridges and roads would provide “anchors” for burn operations (MA-CWPZ-GDL-02; MA-GWPZ-GDL-01). Wildfires managed to meet resource objectives would still be very limited in most montane areas due to concerns that wildfires could become uncontrollable in the dense forests if they burn into these areas (except for in the Kern Drainage).

In alternative B, there is a moderate level of uncertainty in how much prescribed fire could occur in montane areas. There is uncertainty that there would be sufficient time periods or "windows" to conduct prescribed burning because of recent drought, longer fire seasons, mitigations for wildlife, and air quality regulations. Alternative B emphasize designing larger landscape prescribed burns where feasible. The fire management strategy emphasizes restoration along ridges and roads to increase capacity to conduct large prescribed burns:

> During ecological restoration treatments, reduce fuels along ridges, roads, or other natural or man-made features to aid in the use of large prescribed fires and in managing wildfire, including wildfires managed to meet resource objectives.

Restoring prescribed fire in mechanically treated areas is needed to best achieve some of the vegetation desired conditions because mechanical treatments cannot fully mimic the ecological function of fire (TERR-MONT-DC-02), including beneficial effects to fire-adapted plants (see next section on "Terrestrial Ecosystem Processes and Function"). Prescribed fire can reduce and maintain desired conditions by reducing understory vegetation density (like tree seedlings and saplings), reducing and creating shrub decadence (dead branches), and reducing surface fuels and creating patchy distributions of fuels that would result in improved fire resilience.

Composition. Restoration treatments would move vegetation toward desired conditions substantially in treated areas (TERR-MONT-DC-01; TERR-JEFF-DC-01; TERR-DMC-DC-01; TERR-LDGP-DC-01). Treatments would increase the dominance and codominance of Jeffrey pine, especially on dry sites within the two wildfire protection zones. Desired conditions and direction to increase open mature forest patches (TERR-MONT-DC-01; TERR-JEFF-DC-01, -03; TERR-DMC-DC-03, -05; TERR-RFIR-DC-03, 06; TERR-LDGP-DC-01, 03, 06), reduce tree density (cover and basal area), and increase heterogeneity (TERR-FW-GDL-01) would favor the shade-intolerant but drought-tolerant Jeffrey pine. The health and resilience of large pines would be improved by reducing stand density around them, although clumps and groups of large and old trees would be retained. This would increase the likelihood that the current pine trees survive stresses from drought, air pollutants, and climate change (temperature increases). Restoration of heterogeneity through mechanical thinning, and especially prescribed fire would move the composition, condition, and diversity of native understory plants toward desired conditions. Shrubs, flowering plants, and grasses that are adapted to fire would have more vigorous and dense foliage, increased flowering and fruiting, and increased density in a patchy pattern (Fites-Kaufman, Bradley, and Merrill 2006; Wayman and North 2007; Webster and Halpern 2010).

Structure. In alternative B, tree density would be lower and heterogeneity higher in treated patches and across large areas of the landscape. Landscape forest structure would be most changed in the areas with large prescribed fires. This would move some of the landscape toward desired conditions, including heterogeneity at the landscape, patch, and within-patch scales.

Ecological Resilience to Fire, Drought, Air Pollutants, Climate Change, Insects, and Pathogens. In the montane zone, alternative B would promote the resilience to fire, climate change, drought, air pollutants, insects, and pathogens in treated patches (TERR-FW-DC-02; TERR-MONT-DC-01, -03). The elevated restoration treatment rates would build greater adaptive capacity in montane landscapes. Decreased tree density and increased heterogeneity at the landscape and site scales would improve resilience to the multiple stressors (North 2012a). Restoration of more vegetation species resilient to drought, climate and fire (especially Jeffrey pine) would improve overall forest resilience. Increased fire resilience will be most effective Kern Drainage where managed fires have been prevalent (Meyer 2015a) because a sufficient proportion of the landscape would be restored to result in changed fire intensity at the landscape scale (the scale of fires; see the “Fire Trends” section).

Subalpine and Alpine Zone

There would be slight increases in the amount of restoration in subalpine and alpine vegetation. This would be from increased opportunities for wildfire managed to meet resource objectives and potentially from restoration of whitebark pine to reduce damage from white pine blister rust (TERR-ALPN-DC-03). In general, most subalpine and alpine vegetation occurs within wilderness areas where natural processes are the primary emphasis of maintenance and restoration. Little restoration would occur and where it does, it would primarily be limited to small areas in need of rehabilitation from concentrated recreation impacts (e.g., ski areas, campgrounds) or invasive species (DA-WILD-SUIT-01; DA-WILD-GDL-01).

Composition and Structure. Alternative B would improve composition in subalpine and alpine areas through targeted restoration in highly impacted areas (e.g., DA-WILD-GDL-01) and wildfire managed to meet resource objectives. There might be some limited restoration treatments involving control or eradication of nonnative invasive species (like cheatgrass) that would benefit native vegetation, but most of this would occur in foothill or montane areas where they are more impacted. Although fire is naturally infrequent in subalpine and alpine areas, it is an important natural process. More opportunities to manage wildfire to meet resource objectives would restore the effects of this natural process on subalpine and alpine composition and structure.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. In most subalpine forests, alternatives B would promote increased resilience to fire, climate change, drought, insects, and diseases because of higher restoration treatment rates (specifically the restoration of fire). Wildfire would increase resilience primarily through the reduction of stand densities, increased heterogeneity, and promotion of seral class diversity and tree regeneration. In addition, whitebark pine forests located in recreation areas (like ski areas) would be more ecologically resilient under alternative B. Alternative B would likely have greater treatment rates in recreation areas based on a regional whitebark pine restoration strategy. Despite differences among alternatives, many whitebark pine and other subalpine forests would be heavily impacted by insects and diseases associated with increased moisture stress and warming climate conditions under all alternatives (Meyer et al. 2014b, Schwartz et al. 2013b).

Eastside Shrublands and Woodlands (excluding Sagebrush)

Alternative B would have increased vegetation restoration over current levels (TERR-FW-OBJ-01 to 02). There would be more mechanical restoration, primarily thinning or removal of juniper that has invaded historic sagebrush areas. There would also be some restoration of pinyon-juniper to meet desired conditions in areas of tribal importance and in community buffers (TERR-FW-DC-10, 11; TRIB-FW-DC-03 to 05; TERR-FW-OBJ-03). There would be restoration of some areas to reduce and eradicate nonnative annual grasses.

Composition. Alternative B restoration would include actions to control or eradicate invasive plant species in arid landscapes, as described above for sagebrush areas. This would move composition more toward desired conditions. However, as described in the “Sagebrush” section, control and eradication efforts are unlikely to keep up with the proposed increase in treatment rates. There would also be additional restoration in areas of tribal interest that would benefit understory composition, in part through restoring fire with prescribed fire. This would be a result of the relatively greater restoration treatment rates under this alternative compared to alternative A. Where prescribed fire is applied, it would be aimed at primarily positive changes in species composition. This is because fire would be applied in areas with little to no existing cheatgrass and fire prescriptions would be designed to benefit native perennial grasses and other native species. Fire would be applied in a mosaic pattern that would be beneficial to fire-tolerant species and have limited impacts on fire-intolerant species (Brooks and Minnich 2006).

Structure. Alternative B would improve structure in restoration areas. Removal of juniper from sagebrush areas would be the primary means. In other areas, trees would be thinned and heterogeneity increased. There might be some pruning of lower branches where prescribed fire or hand treatments are applied. In restoration areas, vegetation would move toward desired conditions.

Ecological Resilience to Fire, Drought, Climate Change, Insects, and Pathogens. Alternative B would improve resilience to fire, drought, insects, and pathogens to some degree, because of the elevated restoration treatment rates. Restoration would build greater adaptive capacity to climate change than alternative A. Thinning and control and minimization of nonnative invasive grasses would be the primary changes that would increase resilience. There would continue to be elevated levels of insect-related tree mortality in large areas because trees would remain at higher densities in untreated areas. This would especially be the situation on lower elevation sites and more productive sites that have high tree density due to the fire suppression effect.

Eastside Shrublands and Woodlands: Sagebrush

There would be substantially more restoration of sagebrush in alternative B compared to alternative A (TERR-FW-OBJ-01 to 02). This would be to maintain and restore habitat for the greater sage-grouse (SPEC-SG-OBJ-01), reduce fire risk to communities and developed recreation sites, and restore resilience to forests, woodlands and riparian areas (MA-RCA-OBJ-01; FIRE-FW-GOAL-01,-03, and 05). Most of the restoration would be to treat areas with conifer invasion (SPEC-SG-DC-05). There would be more mechanical restoration, primarily thinning or removal of juniper that has invaded historic sagebrush areas. There would be some increases in prescribed fire (TERR-FW-OBJ-02), but it would be limited to smaller areas and carefully applied to avoid invasion and expansion of nonnative annual grasses (like cheatgrass and red brome). There would be restoration of some areas to reduce and eradicate nonnative annual grasses (SPEC-SG-DC-06; INV-FW-OBJ-01) and measures to minimize the spread of noxious weeds (SPEC-SG-GDL-03; SPEC-SG-STD-01) and nonnative invasive plants (INV-FW-GDL-01 to 05). Vegetation treatments and post-soil or other disturbance activities in sage-grouse habitat would be followed by seeding or replanting of sagebrush where appropriate (SPEC-SG-GDL-04). The restoration would occur around communities, in greater sage-grouse habitat that is in poor condition, and in areas of tribal importance (TERR-FW-OBJ-03).

In sagebrush, pinyon-juniper and Jeffrey pine areas, management approaches would be applied that minimize the invasion and spread of nonnative plant species and restore vegetation composition, structure, and resilience. These include:

> Projects in sagebrush should prioritize restoration treatment to remove trees from shrublands, which include recent expansion areas of pinyon and juniper into sagebrush ecosystems and other adjacent shrublands.
>
> Unwanted fire (i.e., more frequent, severe or larger than the natural range of variation) in sage-grouse priority habitat is limited or prevented.
>
> Use an adaptive management strategy shall be used when conducting vegetation treatments within sage-grouse habitat. Treatment methods and intensities will be determined based on the results of past treatments as information from those past

> treatments becomes available. If the results of past treatments show that those treatments have caused an increase in nonnative annual grasses and poor sagebrush recruitment, further treatments within sage-grouse habitat will not adhere to the same prescription.
>
> Where sage-grouse habitat is being degraded due to wild horse and burro use, determine site-specific measures to improve or restore sage-grouse habitat.
>
> Work with tribes to determine priority areas for weed prevention and control, especially focused on traditional gathering areas that are threatened by weed infestations. Consult with tribes before using pesticides or herbicides that may affect traditional gathering.
>
> Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, nonnative species.
>
> Integrate terrestrial ecosystem desired conditions into spatial patterns for fuel reduction treatments. Incorporate heterogeneity by increasing variation in tree spacing, enhancing tree clumps, creating canopy gaps, promoting fire resilient tree species, increasing the ratio of large to small trees, and using topographic variation (e.g. slope, aspect, and position) to guide treatment prescriptions.
>
> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience and fire resilience, and to protect the carbon carrying capacity of the forest.
>
> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.

Composition. Alternative B would promote or sustain the dominance of sagebrush and perennial herbaceous plants in these arid landscapes through ecological restoration treatments. There are specific desired conditions and direction for implementing treatments that would reduce conifer encroachment into sagebrush areas and restore native perennial grasses. Management direction for sage-grouse habitat restoration emphasizes maintenance and enhancement of native plant communities and movement toward vegetation desired conditions (SPEC-SG-DC-05 to 06; SPEC-SG-STD-01, -02, -03, -09). Composition would move toward desired conditions in these areas. However, control and eradication efforts are unlikely to keep up with the proposed increase in treatment rates. Increases in invasive plants are one of the negative effects that the management direction tries to minimize, knowing that the benefits of restoration treatment outweigh this negative effect. Restoration treatment does not eliminate the effect. Where prescribed fire is applied, there would be primarily positive changes in species composition. This is because fire would be applied in areas with little to no existing cheatgrass, and projects would be designed to benefit native perennial grasses and other native species. Fire would be applied in a mosaic pattern that would be beneficial to fire-tolerant species and have limited impacts on fire-intolerant species (Brooks and Minnich 2006).

Structure. Alternative B would improve structure in sagebrush vegetation. Removal of juniper, pinyon pine or Jeffrey pine from sagebrush areas would be the primary means (SPEC-SG-DC-05). Where prescribed fire is restored in sagebrush areas there would be an improvement in structural and age diversity toward the desired conditions.

Ecological Resilience to Fire, Drought, Climate Change, Insects, and Pathogens. Alternative B would improve resilience to fire, and climate change in sagebrush, because the elevated restoration treatment rates under these alternatives build greater adaptive capacity in arid ecosystems than alternative A. Reduced numbers of pinyon and juniper trees, reduced or minimized nonnative annual grass introduction and spread, promotion of native perennial grasses, and increased age and structural diversity of sagebrush would improve resilience to climate and reduce the likelihood of large, high-intensity fires, high-severity fire effects, and poor recovery from fire.

Cumulative Effects of Alternative B

There would continue to be effects of warming and drier climate into the foreseeable future. In some areas, where there is less restoration, the effects of climate change would be more prominent than the restoration benefits because of the low amount, small scale, and limited intensity of restoration (see "Climate" subsection). Areas where there are substantial treatments that would result in improved climate resilience and adaptation are Kern River drainage and restored eastside Jeffrey pine, sagebrush and pinyon-juniper.

There would continue to be restoration on adjacent Federal, State and local agency lands (like Los Angeles Department of Water and Power) that are similar to those on National Forest System lands. Restoration on these other lands would also be limited. There would continue to be urbanized developed adjacent to national forest lands and increased recreational visitor use. There would likely be related increases in human-ignited fires and spread of invasive plants as a result of the combination of increased human presence and climate change. The size and area of large, high-intensity fires would continue to increase (see "Fire Trends" section). Overall, vegetation composition, structure, and resilience would become more dissimilar to desired conditions outside of areas with concentrated restoration. Higher elevation areas would mostly remain moderately similar to desired conditions. Vegetation in the Kern River drainage would potentially increase to high similarity to desired conditions with increased fire because the landscape is moderately resilient to fire and more fire would increase overall resilience.

Consequences Specific to Alternative B-modified

The consequences of alternative B-modified would be similar to alternative B, but there would be a slightly higher restoration treatment rate under alternative B-modified from wildfires managed to meet resource objectives (6,000 acres per decade). This increase in restoration treatment acres would result in about a 2 percent increase in restoration treatment rates for montane forest ecosystems on the Inyo National Forest (Jeffrey pine, dry mixed conifer, and red fir). This slight increase in restoration rates in alternative B-modified will marginally increase the acreage of forest vegetation that is restored to proper structure, composition, and function. In contrast, restoration rates in sagebrush and other arid shrubland and woodland ecosystems will be highly similar between alternatives B and B-modified, because these vegetation types will be restored using approaches other than wildfires managed for resource objectives (prescribed fire and mechanical thinning of encroaching conifers; treatment rates using these approaches are identical under alternatives B and B-modified).

In comparison to alternative B, 133,490 acres (or 7 percent of the total acres on the Inyo National Forest) would be reclassified from the Maintenance or Restoration Fire Management Zone to the General Wildfire Protection Zone in alternative B-modified. Nearly all of these acres are located in lower elevations of the sagebrush vegetation type, where the primary restoration approaches will rely on methods other than wildfires managed to achieve resource objectives (prescribed burning and mechanical thinning of encroaching conifers). Although, this fire management zone reclassification will not result in changes to sagebrush treatment rates, it will result in fewer wildfires burning in this vegetation type in areas with potential for fire-facilitated cheatgrass invasion (see figure 28). Therefore, the reclassification of more acres of sagebrush vegetation to the General Wildlife Protection Zone, and added protection from wildfires and cheatgrass invasion in alternative B-modified will result in more ecologically intact sagebrush ecosystems in alternative B-modified compared to alternative B.

Cumulative Effects of Alternative B-modified

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be reduced similar to alternative B, because increased restoration treatments in alternative B-modified would confer greater adaptive capacity and resilience to forest ecosystems (see “Climate Change” section). Restoration and development on adjacent agency and private lands, as well as urbanization and increased human use would be the same as described for the other alternatives, with increased fire ignitions and nonnative plant invasions (cheatgrass). Overall, vegetation structure, composition, and function would be more similar to desired conditions under alternative B-modified.

Consequences Specific to Alternative C

There is a goal of increased prescribed fire and wildfire managed to meet resource objectives in alternative C. There is a moderate to high uncertainty that increased prescribed and wildfire managed to meet resource objectives would occur in alternative C. One reason is that there would be less mechanical treatment and less opportunity to restore vegetation along ridges and roads that would be used to “anchor” prescribed fire and wildfire managed to meet resource objectives. This is especially a limitation in the Sierra Nevada montane zone, and eastside shrublands and woodlands (especially pinyon-juniper and sagebrush areas) where there are fewer natural features (like rock outcrops) that could be used to burn from or contain fires. Another uncertainty comes from less intense reduction of vegetation density, particularly in mixed conifer forests. This makes prescribing or managing wildfires more difficult because fuel conditions are greater and the risks of managing fires safely and within adequate management control become higher.

Vegetation

Overall, there is substantially less vegetation restoration in alternative C. The consequences of the reduced restoration is that most areas would remain at the same level of dissimilarity to desired conditions as they are now, or decline because of continued effects of fire, spread of nonnative invasive plants, recreation use, and warming climate. Invasive plant treatments would be conducted similarly to other alternatives.

Sierra Nevada Montane Zone

Alternative C would provide some restoration in the Sierra Nevada montane zone but less than in alternatives B and D, at a level similar to alternative A, assuming the rate of prescribed burning compensates for the reduction in mechanical thinning. Most of the mechanical thinning would occur in the wildland-urban intermix defense zone which is managed similar to alternative A. There would be some restoration along ridges and roads. There would be little reduction in forest density and little to moderate increases in heterogeneity in areas treated mechanically. This is because of management direction that limits canopy reductions at the landscape scale and limits the size of trees removed. There is an increased emphasis on prescribed fire but there is a moderate to high uncertainty that much prescribed fire or wildfire managed to meet resource objectives would occur due to most areas continuing to have high fuel levels and conditions that favor high-intensity fire. But there is a higher likelihood of very large, high-intensity fires in alternative C, according to the fire-climate scenario predictions (see “Fire Trends” section).

Composition. The effects of alternative C on composition would be similar to alternative A. Most areas would continue to have a high dissimilarity with desired conditions. There is a potential for more prescribed fire that would improve the condition of understory plants that benefit from fire, but there is a high to moderate uncertainty that this would occur. There would continue to be large areas with more canopy cover at levels outside the natural range of variation and would result in large areas where shade-intolerant pines are in poor condition. There would be less restoration of overstory composition toward desired conditions and less reduction in tree density that shades out a large portion of the understory plants. Where prescribed fire is used in place of mechanical thinning, it could result in less reduction of high density understory seedlings and saplings, especially of shade- and fire-intolerant species such as white fir because the fires may have to be designed to burn with lower intensity to balance damaging larger trees that are desired to be protected. By burning at lower intensity, it may require several re-burn entries over time to achieve the same desired change in composition as achieved in alternatives B and D.

Structure. The effects of alternative C on structure would be similar to alternative A because of the restrictions on canopy cover reductions. There would continue to be large areas that are highly dissimilar to desired conditions. There is the potential for restoration of forest structure toward desired conditions with fire but there is a high uncertainty that prescribed fire and wildfires managed to meet resource objectives would occur to a great extent.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. The effects of alternative C on ecological resilience would be similar to alternative A. Resilience would continue to be very low to low across most of the landscape because vegetation density would remain high and heterogeneity low. Denser vegetation is more susceptible to any additional stress because plants compete more for water, nutrients and light. Wildfire could potentially restore resilience but there is a moderate to high uncertainty that it would occur.

Subalpine and Alpine Zone

Alternative C would have similar effects in subalpine and alpine vegetation as alternatives B and alternative B-modified because management direction in higher elevation and wilderness areas are similar.

Eastside Shrublands and Woodlands (excluding Sagebrush)

Similar to sagebrush, there would be an increase in restoration of pinyon-juniper areas in alternative C compared to alternative A. There would be movement toward desired conditions of composition, structure, and resilience similar to alternatives B and B-modified in the restored areas. Similar to sagebrush, the amount of restored area would be slightly lower than in alternatives B and D. The result is that overall, there would continue to be large areas that have a low to moderate dissimilarity with desired conditions.

There would be very limited restoration of xeric shrub/blackbrush and mountain mahogany, associated primarily with treatment in community buffers. The net effect would be that there would be a limited and negligible movement toward desired conditions of composition, structure, and resilience in these vegetation types.

Eastside Shrublands and Woodlands: Sagebrush

Areas with restoration treatments would move toward desired conditions for composition, structure, and resilience similar to alternative D in areas of sage-grouse habitat restoration and maintenance and similar to alternatives B and B-modified in other areas of sagebrush vegetation. Most of the restoration would involve removal of invading conifers from sagebrush that provides habitat for the greater sage-grouse. Many untreated areas would continue to have a low similarity to desired conditions. In a few areas where montane forest vegetation intersects with sagebrush, there is slightly less restoration treatments in alternative C than in alternatives B and D due to some stewardship opportunity from mechanical thinning in montane vegetation but more than alternative A.

Cumulative Effects of Alternative C

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be more prominent than the restoration benefits because of the low amount, small scale, and limited intensity of restoration in alternative C (see “Climate” subsection). Like other alternatives, there would continue to be restoration on adjacent Federal, State and local agency lands that are similar to those on national forest lands. Restoration on these other lands would also be limited. There would continue to be urbanized developed adjacent to national forest lands and increased recreational visitor use. There would likely be related increases in human fire ignitions and spread of invasive plants as a result of the combination of increased human presence and climate change. The size and area of large, high-intensity fires would continue to increase (see “Fire Trends” section). Overall, vegetation composition, structure, and resilience would become more dissimilar to desired conditions.

Consequences Specific to Alternative D

The greatest amount of restoration would occur in alternative D (table 4, page 83). The increased restoration would include mechanical treatment, prescribed fire, and wildfire managed to meet resource objectives. The combined area of restoration increases from an estimated 48,000 acres in alternative A, to between 90,000 and 100,000 acres in alternatives B and B-modified, to 140,000 acres in alternative D. Some of these acres may include areas with overlapping treatments, meaning some of the areas may be treated with both mechanical treatment and prescribed fire or mechanical treatment and managed fire.

Most of the increased restoration would occur in the Jeffrey pine, pinyon-juniper, and sagebrush ecosystem types. Overall, alternative D emphasizes more rapidly restoring vegetation resilience recognizing there may be short-term consequences. There are fewer wildlife-related restrictions on vegetation restoration in alternative D, especially more flexibility in limited operating periods and an increase in the amount of habitat that can be restored in the short term to achieve greater long-term benefits.

Restoration in alternative D would include the same management direction as alternatives B and B-modified described above to limit the introduction and spread of nonnative invasive plants. Any associated improvements to native plant composition may be offset to an unknown degree by nonnative invasive plant expansions in restoration areas, despite best management practices since climate change can favor the growth and spread of invasive species.

Restoration in alternative D would be similar to alternatives B and B-modified in location but the area restored would increase substantially. This includes areas around communities and developed recreation sites, sagebrush areas with encroaching conifers, Jeffrey pine departed from the desired conditions, dense pinyon-juniper woodlands, and some other areas with nonnative plant invasions.

Vegetation

The dominant eastside vegetation types (sagebrush, Jeffrey pine, and pinyon-juniper) would move toward desired conditions with restoration treatments, similar to alternatives B and B-modified. There would be more area restored in the middle elevations in alternative D that would result in movement toward desired conditions for composition, structure, and especially resilience at the landscape scale. There would be more removal of invading conifers in sagebrush areas, along with control and eradication of nonnative invasive plants. There would be larger areas of Jeffrey pine where tree density is reduced, heterogeneity is increased, surface fuels are reduced, and understory composition is restored. There would be substantially more area of pinyon-juniper with reduced density and nonnative invasive plants eradicated or controlled.

Sierra Nevada Montane Zone

Alternative D would have the greatest amount of restoration in the Sierra Nevada montane zone. Restoration would focus on the Jeffrey pine vegetation type but also include treatments within dry mixed conifer, red fir, and some lodgepole pine, especially within the Mammoth Lakes and June Lake area. The concentration of restoration in landscape areas would result in a higher likelihood that these areas would burn at lower intensities during wildfires and retain mature forest.

The amount of prescribed fire and wildfire managed to meet resource objectives would be greatest in alternative D. The total amount of prescribed fire would be about 10 to 30 percent higher than alternative A, and the total amount of wildfire managed for resource objectives would be a substantially higher than alternatives A, B, B-modified, and C. The increase would be due to the greater amount of mechanical restoration and emphasis on increasing the use of fire as a restoration tool and to restore it as an ecosystem process to these frequent fire-adapted and fire-deficit ecosystems. The mechanical restoration would focus first on strategically placed areas on ridges, along major roads, and other strategic locations that can serve as future fuel treatment “anchors” for the safe and effective reintroduction of fire (North, Collins, and Stephens 2012; North et al. 2015). The purpose of these strategic areas is to improve the ability to safely and effectively conduct large prescribed fires, suppress fires, and to manage wildfires in a manner that results in beneficial fire effects that enhances protection of communities and restores ecosystems. There would also be more prescribed fire in and between areas restored mechanically. Larger prescribed fires would be more feasible because vegetation would be less dense, making desired fire effects and fire control more achievable. There would be a lower likelihood of sustained crown fire. There is a moderate level of uncertainty that the planned amount of prescribed fire would not occur because of air quality constraints.

Composition. Restoration treatments would substantially increase the dominance and codominance of Jeffrey pine, especially on dry sites. Desired conditions and direction to achieve them include decreased tree density (cover and basal area) and increased heterogeneity. These would favor the shade-intolerant pine. The health and resilience of large pines would be improved by reducing stand density around them, although clumps and groups of large and old trees would be retained. This would increase the likelihood that the current pine trees survive stresses from drought, air pollutants, and temperature increases related to climate change.

Restoration of heterogeneity through mechanical thinning, and especially prescribed fire and fire managed to meet resource objectives would improve the composition, condition and diversity of native understory plants. Shrubs, flowering plants, and grasses that are adapted to fire would have more vigorous and dense foliage, increased flowering and fruiting, and increased density in a patchy pattern.

Structure. In alternative D, tree densities would be lower and heterogeneity considerably higher across large areas of the landscape. The landscapes would be most changed in the protection zones, but also in the restoration zones accessible by road and equipment and feasible for large landscape prescribed fire. This would move substantial portions of the landscape toward desired conditions.

Ecological Resilience to Drought, Air Pollutants, Climate Change, Insects, and Pathogens. In montane forests, this alternative builds greater adaptive capacity than other alternatives. Decreased tree density and increased heterogeneity at the landscape and site scales would improve resilience to these multiple stressors. Higher levels of prescribed fire associated with increased mechanical treatments and large prescribed fires in other areas would decrease surface fuels and increase resilience to large, high-intensity fire more than other alternatives.

Subalpine and Alpine Zone

Overall, alternative D would have similar consequences to alternatives B, B-modified, and C in subalpine and alpine vegetation. Wildfire managed to meet resource objectives would increase resilience fire, drought, climate change, and to insects and diseases primarily through the reduction of stand densities and promotion of diversity of species, and structures, and tree regeneration. Whitebark pine forests located in recreation areas (like ski areas) would potentially be more resilient to insects and diseases under alternative D. Alternative D would have greater treatment rates in recreation areas based on a regional whitebark pine restoration strategy.

Despite differences among alternatives, many whitebark pine and other subalpine forests would be heavily impacted by insects and diseases associated with increased moisture stress and warming climate conditions under all alternatives.

Eastside Shrublands and Woodlands (including Sagebrush)

Alternative D would promote the greatest resilience to climate change in the eastside shrublands and woodlands, because the elevated restoration treatment rates under these alternatives build greater adaptive capacity in these arid ecosystems (especially in the sagebrush and pinyon and juniper vegetation types) than alternative A. A substantial portion of the landscape would have increased resilience to large, high-intensity fire and lower risk of nonnative invasive plants spreading in burned areas, especially cheatgrass and other highly flammable grasses. Decreased nonnative plant spread would have an additional positive effect of further reducing the likelihood of large, high-intensity fires. These long-term improvements may be offset to an unknown degree by nonnative invasive plant expansions in restoration areas, despite best management practices since climate change and treatment activities themselves can favor the growth and spread of invasive species.

Cumulative Effects of Alternative D

There would continue to be effects of warming and drier climate into the foreseeable future. The effects of climate change would be somewhat reduced because of the increased climate resilience that results from the substantial amounts, scale, and intensity of restoration treatments in alternative D (see “Climate Change” section). Restoration and development on adjacent agency and private lands, as well as urbanization and increased human use would be the same as described for the other alternatives, with increased fire ignitions and invasive plant spread occurring. Overall, vegetation composition, structure, and resilience would become more similar to desired conditions.

Analytical Conclusions

Sierra Nevada Montane Zone

Alternative D followed by alternatives B and B-modified would move the most area toward and closest to the desired conditions for vegetation ecology. The higher rates of treatment and emphasis on treating across larger areas would be more likely to result in entire landscapes that are restored within the next 10 to 15 years. This increases the likelihood that large landscape areas are not only restored but that they can withstand fires of all intensities and still maintain much of their forest structure and composition with moderate or mixed severity and limited large patches of high-severity fires. While small, distributed pockets of high-severity fire can provide heterogeneity and old forest and complex early seral forest (see “Complex Early Seral Forests” in the following section), very large fires are outside of the desired condition.

The beneficial effects of alternative D are greater than in alternatives B and B-modified. This would result in a higher level of resilience across larger landscape areas that would improve the resilience of adjacent areas.

Alternatives A and C are both likely to result in low levels of restoration treatments. Vegetation is likely to remain highly dissimilar to desired condition for structure, composition and resilience across most of the landscape. The increased emphasis in alternative C on prescribed fire and wildfire managed to meet resource objectives may result in some increases in areas restored by fire. But these may be more limited than intended because of the low levels of accompanying mechanical treatment in strategic locations that would aid in conducting more large prescribed burns or benefiting from wildfires.

There is a relative difference among the alternatives in the cumulative environmental consequences. This is especially the case with the overlaid consequences of climate warming and increased probability of large, high-intensity fires on top of the restoration treatments. The trend for increasing large, high-intensity fire is highly likely to continue in all alternatives, but there will be a lower probability in alternative D and a slightly lower probability in alternatives B and B-modified based on the fire-climate restoration scenario research (Westerling, Milostan, and Keyser. 2015).

Subalpine and Alpine Zone

Alternatives B, B-modified, C, and D would move the greatest amount of subalpine and alpine vegetation toward the desired conditions. The higher restoration treatment rates under these alternatives build greater adaptive capacity in many subalpine landscapes than alternative A. Alternative A will likely support the slowest rate of return to desired conditions and promote the least long-term resilience to stressors. This is a consequence of the lower treatment rates under alternative A, especially the use of wildfires managed to meet resource objectives. Alternative A is also the only alternative that does not involve the creation of an interagency whitebark pine conservation and restoration strategy. Under alternatives B, B-modified, C, and D, this strategy would enhance the success of whitebark pine and other subalpine forest restoration efforts in the southern Sierra Nevada. This would be particularly evident in recreation areas where increased treatment rates would build greater adaptive capacity.

Under all alternatives, alpine vegetation would have low resilience to climate change, because these high-elevation vegetation types have high exposure to the effects of climate change and low adaptive capacity to changing climate under all climate scenarios (Safford, North, and Meyer. 2012; Lenihan et al. 2003 and 2008). Active management is also similarly limited in alpine environments in all alternatives, which further limits the adaptive capacity of alpine ecosystems under any one alternative. Consequently, there are no differences among alternatives with respect to the maintenance of desired conditions in alpine ecosystems.

Eastside Shrublands and Woodlands (excluding Sagebrush)

Alternative D, followed by alternatives B and B-modified, would move the greatest amount of pinyon-juniper vegetation toward desired conditions. Increased treatment rates and intensity would restore less dense and more heterogeneous structure, and reduce nonnative invasive plants. These changes would increase the resilience to drought, insects and pathogens, climate change, and fire. Alternative A would have the least restoration of all alternatives, but alternative C would have only slightly more restoration treatments. Under both alternatives A and C, most pinyon-juniper vegetation would remain dissimilar to vegetation desired conditions.

Under all alternatives, there would be a similar, low amount of restoration in xeric shrub/blackbrush and mountain mahogany vegetation types. These vegetation types would remain moderately dissimilar to desired conditions. There would be beneficial effects of all alternatives on these arid shrublands, through eradication or control of nonnative invasive plants on adjacent sagebrush, pinyon-juniper and Jeffrey pine vegetation. This would reduce the likelihood of spread of nonnative invasive plants into the arid shrublands.

Eastside Shrublands and Woodlands: Sagebrush

Similar to other eastside shrublands and woodlands, Alternative D followed by alternatives B and B-modified would move the greatest amount of sagebrush toward the desired conditions. The higher treatment rates in these alternatives would more likely result in landscape-scale restoration in the next 10 to 15 years. The greater restoration treatment rates in sagebrush landscapes increases the capacity of component ecosystems to resist nonnative plant invasions and maintain much of their desired structure and composition despite climate change. Alternative A would likely result in lower restoration treatment rates than other alternatives. Consequently under alternative A, vegetation would likely remain dissimilar to the desired condition in structure, composition and resilience across many arid landscapes. Alternative C would have only slightly greater restoration treatment levels than alternative A; resulting in continued dissimilarity of sagebrush vegetation to desired conditions in most areas.

Terrestrial Ecosystem Processes and Functions

Background

Functions of terrestrial ecosystems can refer to many things. Here, the primary functions considered include how vegetation and terrestrial ecosystems provide for carbon cycling and regulation, fire regimes as an ecological process, terrestrial biodiversity that includes old forest and complex early seral forest habitats and habitat for pollinators and tree cavity excavators (like woodpeckers), and connectivity for species across landscapes.

This section also contains an integrated analysis of varied aspects of biodiversity and ecological sustainability from other sections and multiple supplemental reports. This includes an integrated analysis of ecosystem condition in relation to tribal uses, fire regime and fire effects information, and important seral stages. Tribes have lived with and relied upon terrestrial (and aquatic and riparian) ecosystems in the analysis area for thousands of years. In this section, the condition of plants, animals, and overall terrestrial ecosystems in relation to tribal uses is analyzed. Overall sustainability will draw upon broad measures of ecological integrity identified in the National Ecological Sustainability Frameworks (USDA Forest Service 2004a, 2011a) including vegetation condition, air pollutant exposure, insect and pathogen levels, and fire regimes. All of these aspects of terrestrial ecosystem function are described below.

In addition to the broad ecosystem approach of vegetation analysis that emphasizes dominant vegetation types, we also recognize that some plant communities or habitats are less common and provide important ecological conditions for at-risk species. Some special habitats are important for ecological integrity because they are limited to small areas with uncommon rock types and/or soils types, called “edaphic habitats” or they provide essential microclimate conditions surrounding habitats for at-risk species with a restricted distribution. Other special habitats include cliffs and caves essential for at-risk species. The analysis of special habitats is discussed in the “Wildlife, Fish, and Plants” section, especially under the subsection “At-risk Plant Species.”

Analysis Methods and Data Sources

The overall approach in this analysis was to evaluate the similarity of current and estimated future conditions to the desired conditions where possible. The desired conditions for most of these indicators are broadly defined because there is less specific best available scientific information and other sources on which to base them, or there is more uncertainty as to what desired conditions should be. Therefore, the evaluation is mostly a qualitative evaluation of relative differences in trends toward the desired conditions. In some cases there was quantitative information available to make the evaluation, such as aspects of old forest and complex early seral forests. For both types of evaluations, the specific indicators, measures, thresholds for levels of similarity between desired conditions and current or future conditions, and associated assumptions were identified.

Indicators and Measures

Fire Regimes and Fire as an Ecological Process

Fire is a “keystone” ecosystem process in most of the analysis area (McKelvey 1996, van Wagtendonk and Fites-Kaufman 2006, Brooks and Minnich 2006); (Wills 2006). This means that it has important and often dominant influences on ecosystem composition, structure, and function. Fire shaped most of the ecosystems. Deserts and alpine ecosystems are two exceptions.

Fire Regimes. The fire regime is the pattern of frequency, intensity, severity, seasonal timing, and spatial pattern of fires (Sugihara et al. 2006). Three measures of fire regimes were used here: (1) the frequency of fire, (2) the fire regime condition class, and (3) a qualitative analysis of fire regime integrity. Fire regime integrity refers to the similarity of all aspects of fire regimes compared to the historic patterns (prior to European settlement). Additional analysis and discussion of fire regimes by individual major vegetation types is addressed in the “Terrestrial Vegetation Ecology” section. This includes fire severity and spatial patterns.

Fire Effects. Ecological fire effects refer to how vegetation is affected by fire (for example, whether it is invigorated and sprouts, or killed). Many plants in the analysis area are adapted to fire and can respond positively to it, depending upon the intensity and duration of the fire and the extent (Fites-Kaufman, Bradley, and Merrill 2006). Here a broad analysis was conducted. Specific effects to different vegetation types are described in the “Terrestrial Vegetation Ecology” and “Aquatic and Riparian Ecosystems” sections.

Carbon Stocks, Sequestration, and Stability

The primary criteria used to analyze carbon stocks, sequestration, and stability were the resilience to fire, climate, and insects and pathogens. In dry forest systems, there can be dramatic changes in carbon stocks and sequestration capacity with one large, high-intensity fire (North 2014). Carbon stability was a focus of analysis because managing for long-term carbon stability, within a carbon carrying capacity, is a forest-wide desired condition. Carbon stocks and sequestration are both dependent on the carbon carrying capacity, and, consequently, highly related to the carbon stability of an ecosystem. In arid, eastside shrublands and woodlands, soil carbon was emphasized.

Connectivity

The ability for species to move throughout a landscape is important for ecological integrity (Rudnick et al. 2012). Species that are wide ranging are able to maintain genetic diversity and sustainability in the face of changes to their population or environment (Gilbert-Norton et al. 2010). Connected landscapes allow other species to migrate in the face of climate change or other pressures (Heller and Zavaleta 2009). Despite its ecological importance, in practice connectivity is a very difficult concept to apply because it depends on the species and its associated life history and dispersal characteristics (Cushman, Landguth, and Flather 2012). Connectivity for wide-ranging habitat specialists (like the greater sage-grouse or marten) are different than for generalists (like bears) or short-dispersal specialists (like plants growing on certain rock types). For this analysis, the emphasis was on broad patterns of vegetation structure or landscape arrangement of vegetation and some aspects of connectivity function. Functional aspects included existing and predicted habitat fragmentation for vegetation types and important seral stages (like old forest) and landscape patterns of broad management intensities including less managed areas (such as wilderness), varying road densities (Cushman and Landguth 2012), and different large fire probabilities.

Terrestrial ecosystem connectivity was analyzed at multiple spatial scales. These are all related but focus on different aspects of terrestrial ecosystem connectivity. Most of the analysis was qualitative, based upon key sources of connectivity presented in the assessments (such as the State of California Essential Habitat Connectivity project, Sierra Nevada Ecosystem Project Areas of Late Successional Emphasis) and maps of broad management regimes (like wilderness) by alternative. Connectivity of old forest and complex early seral habitats, which are described in more depth in the supplemental reports on that topic.

Thresholds were based upon general connectivity theory, especially for wide-ranging wildlife. There are many different ways to measure connectivity but for a general view, percolation theory is useful. Percolation theory suggests that when the majority of a landscape has conditions suitable for movement, then movement is more likely to occur (Turner 1989, Metzger and Décamps 1997, Kindlmann and Burel 2008). It matters less how habitat is arranged when there is more of it. The thresholds vary by species habitat requirements and mobility. For this analysis, we assumed that landscapes with greater than 60 percent habitat suitable for movement provided high connectivity. Some research suggests that the threshold is greater than 40 percent. For this analysis we assumed that 40 to 60 percent provided moderate levels of habitat connectivity. In addition to the amount and distribution of habitat, areas that block or constrict movement, such as large reservoirs or major highways can influence connectivity. Since this is a general landscape view of connectivity, we assumed that relative differences in the number of major barriers provided relative differences in the ability of wide-ranging species to move through the landscape.

Criteria and thresholds for environmental analysis of landscape connectivity across vegetation types within the Sierra Nevada montane ecological zone and eastside shrublands and woodlands are shown below.

Indicator: Connectivity for wide-ranging montane forest species (bear, deer, marten; see also “Old Forest” below).

Criteria:

- Major barriers and connecting habitat with hiding cover (overhead shrub and/or tree cover).
- Location of and amount of barriers (such as large reservoirs, developed areas, major roads, high road density)

Thresholds and Evaluation Approach:

- High: No major barriers preventing dispersal of sensitive species; greater than 60 percent of the landscape with hiding cover.
- Medium: Pinch points or barriers exist in limited places; 30-60 percent of the landscape with hiding cover.
- Low: Multiple pinch points or barriers; less than 30 percent of the landscape with hiding cover

Criteria and thresholds for environmental analysis of landscape connectivity across vegetation types across eastside landscapes (sagebrush and pinyon-juniper) are shown below:

Indicator: Connectivity for sage-grouse and other sagebrush-dependent species.

Criteria:

- Major barriers and, amount and distribution of connecting sagebrush habitat
- Location and amount of barriers (such as large reservoirs, developed areas, major roads, high road density).
- Extent of area with moderate sagebrush cover without encroaching conifers (like juniper)

Thresholds and Evaluation Approach:

- High: No major barriers preventing dispersal of sagebrush species, greater than 60 percent of landscape with sagebrush cover.
- Moderate: Pinch points or barriers exist in limited places, 30-60 percent of the landscape with sagebrush cover.
- Low: Multiple pinch points or barriers exist. Less than 30 percent of the landscape with sagebrush cover.

Terrestrial Biodiversity

The analysis of important aspects of terrestrial biodiversity, including old forest and complex early seral forest habitat (important seral stages), and keystone groups (pollinators and cavity excavators) adds to the course filter vegetation analysis above. These are important aspects of biodiversity and support the fine-filter analysis of biodiversity by individual species in the sections for at-risk terrestrial wildlife and plant species. It provides an evaluation of the extent to which plan components that provide ecosystem diversity will also provide the ecological conditions necessary to support species of conservation concern.

Old Forest and Complex Early Seral Forest

There are two specific seral stages that provide important habitat for terrestrial biodiversity in Sierra Nevada montane forests: old forest (table 33) and complex early seral forests (table 34).

Old forest was analyzed by comparing conditions and trends with similarity to desired conditions for large tree densities and landscape proportions of old forest (table 32).

Table 33. Indicators, criteria and thresholds used to analyze environmental consequences for the old forests (Sierra Nevada montane zone only)

Old Forest Characteristic	Criteria	Thresholds for Qualitative Evaluation of Trends
Large trees	Densities compared to desired conditions	Relative trends (increase, decrease, stay the same)
Amount of old forest	Proportion of landscape with large trees (size varies by species, see desired conditions)	high = more than 60 percent of landscape moderate = 40-60 percent of landscape low = less than 40 percent of landscape
Large snags (larger than 20 inches diameter at breast height)	Density (per 10 acres) and variability (range in densities) compared to desired condition	high = 20-40 per 10 acres moderate = 5-20 per 10 acres; low = less than 5 per 10 acres

Table 34. Indicators, criteria and thresholds used to analyze environmental consequences for complex early seral forest (Sierra Nevada montane zone only)

Complex Early Seral Characteristic	Criteria	Qualitative Evaluation of Consequences
Amount/Proportion of montane forest landscape	Proportion of landscape (across the Sierra Nevada montane forest zone) that is classified as complex early seral and its comparison to the natural range of variation	Relative evaluation of the trends in amount and levels of departure from the natural range of variation
Spatial pattern	Evenness in distribution across landscape, and grain (size of patches) relative to natural range of variation	Relative evaluation of pattern compared to desired conditions

These desired conditions recognize a “gradient” approach to defining old forest (Franklin and Fites-Kaufman 1996; Spies 2004). That means that there are different degrees of what is considered old growth. Areas that have high densities of large trees relative to the natural range of variation (the median and high range of desired conditions) are at one end of the old forest spectrum, and areas with low densities of large trees (the low range) are at the other end of the spectrum. Because of the long history of selective removal of large, old trees in the analysis area (Mckelvey and Johnston 1992), areas that have low densities are more common (Franklin and Fites-Kaufman 1996). While even single large, old trees can be ecologically important given this history and current patterns, old forest is still focused on large, old trees within an area. The analysis reflects this gradient approach and wide range in current conditions in large tree densities.

Complex early seral was analyzed by examining: (1) anticipated temporal trends, (2) proportional abundance relative to the natural range of variation, and (3) spatial patterns such as the patch size and evenness in distribution.

Keystone Groups (Pollinators and Cavity Excavators)

Some plants, animals, insects, and fungi stand out in their role in ecosystem function. Pollinators are one such group. They include mostly insects, including butterflies and bees, but also other animals, like hummingbirds. Without these pollinators, many flowering plants would fail to persist or be rare on the landscape. This would then have repercussions on other insects and animals that use these plants for food and shelter.

Another standout group is woodpeckers and other primary cavity excavators (such as nuthatches and sapsuckers) because they make cavities that are used by many other birds and mammals. For this analysis, these two keystone groups were selected as important, but it is not meant to imply that there might not be other ones. These are two groups that might be impacted by treatments. The analysis of consequences to pollinators and cavity excavators was qualitative. Findings on climate, fire, insects, pathogens, vegetation, less common habitats, and at-risk species were synthesized.

For pollinators, three recent management strategies were used to identify measures and practices to analyze. These all incorporate summaries of research key elements of pollinator habitat and management approaches. These include the "Pollinator Research Action Plan" by USDA and EPA (2015), "Region 5 Draft Pollinator Best Management Practices" (Van Zuuk 2014), and "Pollinator Friendly Best Management Practices for Federal Lands" (United States Departments of Agriculture and Interior 2015). The key element of pollinator habitat is the abundance, condition, and spacing of flowering plants in the landscape. Openings in forests and sunny areas are identified as important and dense forests as a concern. Also important are nearby water sources, and nesting habitat that is widely varied and can include holes in the ground, logs, hollow or pithy shrub stems, and snags. Continuously burned areas can be detrimental but fire can also improve understory plant flowering. Any activity or management action that removes or reduces flowering can have impacts including intensive grazing, recreation use, mowing, or herbicides. For this analysis, changes to forest heterogeneity that create openings, and restoration of low and moderate-intensity fire were used to evaluate environmental consequences as described below.

Indicator: Understory plant composition, condition and distribution

Criteria:

- Amount of sunny openings or overstory heterogeneity in forests.
- Amount and type of fire relative to the natural fire regime (enhances native flowering plants).

Thresholds:

- High: Dominant vegetation is mostly (greater than 60 percent) within the desired conditions for structure and fire regimes. Fire is restored to many areas in historically frequent fire ecosystems. Nonnative plants are limited in extent.
- Moderate: Dominant vegetation is somewhat (30 to 60 percent) within the desired conditions for structure and fire regimes. Fire is restored to some areas in historically frequent fire ecosystems. Nonnative plants are present in some areas.
- Low: Dominant vegetation is mostly (less than 30 percent) outside of the desired conditions for structure and fire regimes. Fire is restored to limited areas in historically frequent fire ecosystems. Nonnative plants are present in numerous areas, dominant in some larger areas.

For primary cavity excavators, primarily woodpeckers, snags are a primary habitat. Many species of woodpeckers use a variety of snag sizes in a variety of forest conditions. This includes small to large snags in young to old forests (used by white headed and pileated woodpeckers (Bull and Holthausen 1993, Morrison et al. 1987, Raphael and White 1984), or unburned to burned forests (used by black-backed woodpeckers; Saracco, Siegel, and Wilkerson 2011; Fogg, Roberts, and Burnett 2014; Siegel et al. 2014). The amount and distribution of snags in varied forest conditions was used to evaluate environmental consequences as described below.

Indicator: Amount and distribution of snags in both burned and unburned forests. Diversity of snag habitats.

Criteria:

- Density and variation in size and decay class of snags compared to desired conditions. Spatial pattern (evenness across larger areas but clumpy patterns at smaller scales). Presence in multiple forest conditions and settings (young forests, old forests, burned forests, and unburned forests).

Thresholds:

- High: Snag densities and distribution are within the desired conditions across most the landscape. These occur in a variety of forest ages and burned and unburned conditions.
- Moderate: Snag densities and distribution are somewhat within the desired conditions across the landscape. These occur in a variety of forest ages and burned and unburned conditions but may be missing in some areas.
- Low: Snag densities and distribution are within the desired conditions across limited areas the landscape. These occur in some forest age classes and burned and unburned conditions but are missing across significant areas.

Tribal Uses and Biocultural Diversity

Native Americans have lived throughout the analysis area for thousands of years (Lake and Long 2014b). The people of various Tribes have historically and are currently tied to different ecosystems across the area that provide for basic life needs of food, shelter, and culture. Plants, animals, springs, and seeps across all elevational zones and vegetation types are often important to Tribes. There are strong ties between Tribes and all components of ecosystems. The condition of biodiversity thus can impact cultural diversity, or the ability of Tribes to maintain their culture. The condition and distribution of these culturally important aspects of ecosystems is the focus of this section.

A qualitative analysis was conducted for tribal uses and biocultural diversity. This included a synthesis of the findings in the Vegetation Ecology, Fire Ecology, and Vegetation Resilience supplemental reports, and discussions in numerous tribal forums over the last several years.

Terrestrial Ecosystem Sustainability

The National Forest Sustainability Framework (USDA Forest Service 2004a, 2011a) was used to evaluate terrestrial ecosystem sustainability considering aspects of biodiversity and ecosystem processes (table 35). This includes ecosystem resilience, connectivity, vegetation condition, insect and pathogen processes, fire regimes, species diversity and at-risk species. This section draws upon findings in the sections discussing “Agents of Change,” “Terrestrial Vegetation Ecology,” “Fire Ecology,” and “At-risk Species.”

Table 35. Characteristics from the National Forest Sustainability Framework used in the analysis

Characteristic	Analysis
Area affected by insects and pathogens beyond natural range	Summary from the "Insects and Pathogens" section in the "Agents of Change" section
Area affected by air pollutants that may cause negative effects	Summary from the "Air Quality" section
Area affected by invasive species	Summary from the "Terrestrial Vegetation Ecology" section
Area with fire condition class outside of natural range	Summary from the "Fire Regimes and Fire as an Ecological Process" section
Area with vegetation condition outside of natural range	Summary from the "Terrestrial Vegetation Ecology" section

Affected Environment

A summary of the current conditions of carbon, connectivity, old forest, complex early seral habitat, limited habitat types, and tribal uses are shown in table 36. The conditions are described in broad terms in relation to the desired conditions by ecosystem types (see "Terrestrial Vegetation Ecology" section for descriptions).

Table 36. Summary of the similarity of current conditions to desired conditions for major indicators of terrestrial function by ecosystem type

Ecosystem Type	Fire Regimes and Fire as an Ecological Process	Carbon Stability	Landscape Connectivity	Old Forest Condition and Amount	Complex Early Seral Forest	Tribal Uses, Biocultural Diversity (Conditions)
Jeffrey Pine and Dry Mixed Conifer	Low	Low	Moderate	Low	Moderate to High	Low
Red Fir and Lodgepole Pine	Low to moderate	Low to moderate	High	Moderate	High	Moderate
Subalpine	High	Moderate	High	High	NA	Moderate
Alpine	High	Moderate	High	NA	NA	High
Sagebrush	Moderate	Moderate	Low To Moderate	NA	NA	Low
Pinyon-Juniper	Moderate	Moderate	Moderate	Moderate	NA	Moderate
Xeric Shrub/Blackbrush and Mountain Mahogany	Moderate	Moderate	High	NA	NA	Moderate

NA = not applicable

Fire Regimes and Fire as an Ecological Process

Fire Return Interval Departure

Historically (before 1850), the area that burned in the analysis area and California overall was estimated to be vastly greater than current patterns (Stephens, Martin, and Clinton 2007). These changes have not been uniform. The frequency of fire has decreased the most in eastside Jeffrey pine, and dry mixed conifer forest types. These forests used to burn on average every 10 to 15 years (Van de Water and Safford 2011). Higher elevation red fir forests have longer fire return intervals and have changed less, only missing one or two burn cycles on average (Safford and Van de Water 2014). Subalpine and alpine areas have changed little if at all. Although lightning strikes often hit the crest where they occur, the sparse vegetation carries little fire. In sagebrush, pinyon-juniper and other eastside shrubland and woodland vegetation types, the level of fire regime interval departure is low but variable (Safford and Van de Water 2014). Where there have been invasions of nonnative, annual cheatgrass, fire is becoming more frequent than historically (Chambers et al. 2014). Other areas have had some declines in fire frequency, such as sagebrush ecosystems in the absence of cheatgrass invasion.

The fire return interval departure index is one way of showing changes in fire frequency (Van de Water and Safford 2011). The maps below show fire return interval departure for the Inyo National Forest (figure 30). This map is based on van de Water and Safford (Van de Water and Safford 2011, Safford and Van de Water 2014). The departure is based upon the difference between the current fire frequency (average years between fires) and historic fire frequency. High departure can represent a lack of fire (shown in red, minus 66 percent) or too frequent fire (shown in dark blue, plus 66 percent). A moderate departure, can represent a lack of fire (orange, minus 33 percent) or too frequent return of fire (light blue, plus 33 percent). A low departure, shown in green and yellow, represent less than a 33 percent change in fire frequency. Recent fires are shown as transparent shaded areas. The fire return interval departure values are based on the most recent departure data that includes fires since 2016.

Vegetation types where fires burned most frequently in the past, such as Jeffrey pine or dry mixed-conifer, have “missed” the most historic fire return intervals and have undergone the sharpest decline in ecological condition. Jeffrey pine and dry mixed conifer have generally experienced a two-thirds decrease in mean percent fire return interval departure, which is categorized as high departure. This pattern of high fire return interval departure in Jeffrey pine and dry mixed conifer forests of the plan area is similar to other regions of the Sierra Nevada and California (Safford and Van de Water 2014). As an exception, the Kern Plateau across the southern Inyo is characterized by relatively low levels of departure (fire return intervals are closer to the natural range). This is because there have been extensive areas of wildfires managed to meet resource objectives in this area (Meyer 2015a).

Subalpine forests, where fires were historically less frequent due to the patchier and sparse vegetation and shorter fire season, have undergone fewer changes. Red fir and lodgepole pine forests have had moderate departure in fire frequency because fires in these forest types were historically less frequent (Meyer 2013a, 2013b). Currently the departure is low in higher elevations of red fir and subalpine forests, but projected increases in fire frequency with climate change may reduce this departure over time.

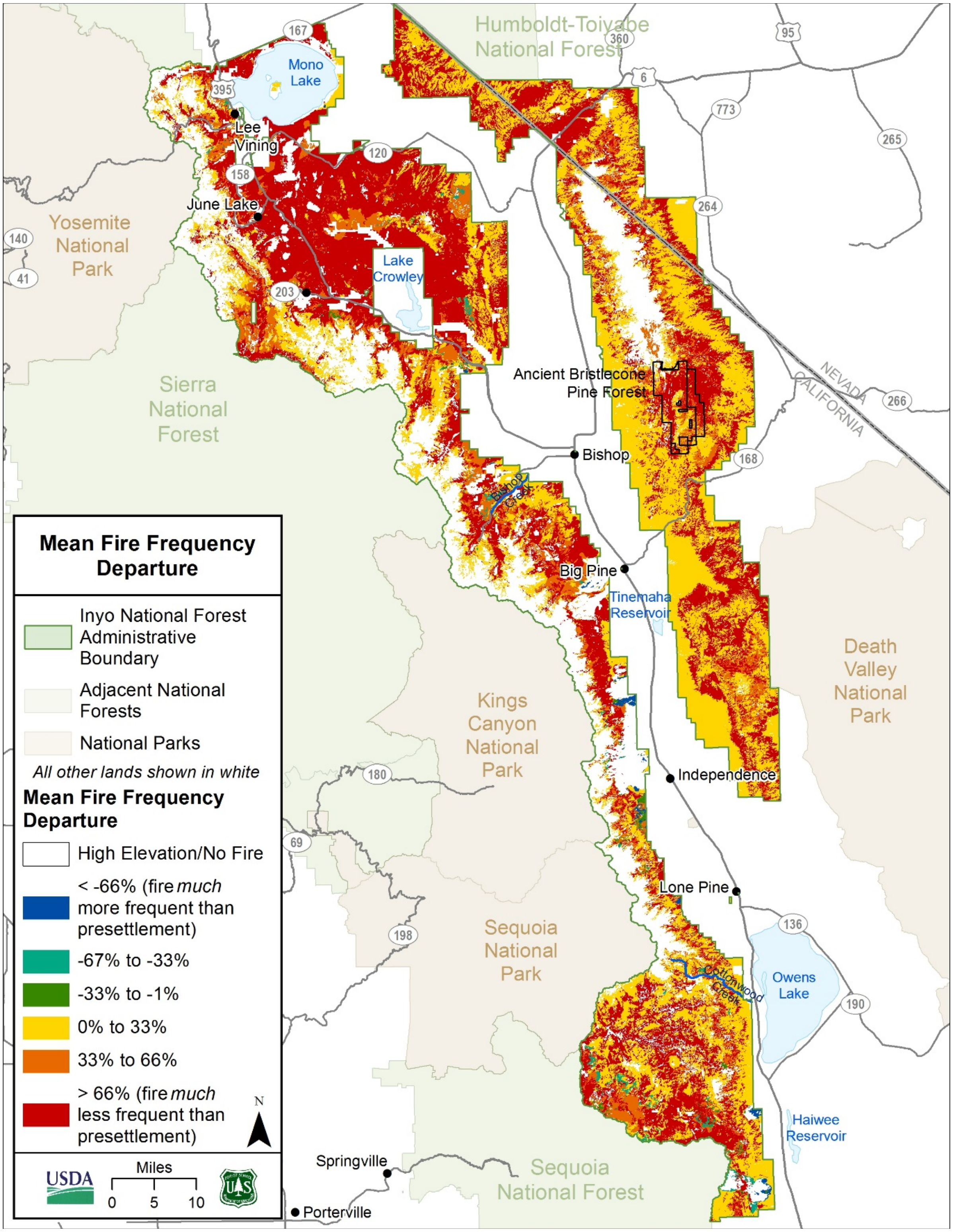

Figure 30. Map of fire return interval departure, Inyo National Forest

The departure in eastside sagebrush and pinyon-juniper ecosystems is varied from low to moderate. Sagebrush ecosystems show moderate levels of fire return interval departure, but pinyon-juniper, mountain mahogany, and xeric shrub/blackbrush vegetation generally have low to moderate levels of departure. Where cheatgrass or other invasive annual grasses has invaded eastside shrubland ecosystems, fires are more burning more frequently than historically resulting in moderate to high fire return interval departure (bluish or aqua greenish colors in figure 30.

Fire Regime Integrity

In addition to the occurrence and frequency of fire, the type of fire (surface, passive crown, or active crown fire) and severity of fire are important aspects of fire regimes. Many factors influence how severe a fire affects vegetation. This includes the density, size, species, and condition of vegetation as well as the intensity (heat level), speed (spread rate), and duration (length of time heat is emitted) of a fire. In much of the analysis area, decreased fire frequency as a result of aggressive fire suppression in combination with past forest management has led to denser, more uniform vegetation. This densification, especially in forests that historically burned frequently (Jeffrey pine and dry mixed conifer) promotes more severe fire effects, including higher proportions and patch sizes of high-severity fire under contemporary conditions than under the natural range of variation (Safford et al. 2013a). Table 37 shows the current condition of fire regime integrity for the Inyo National Forest ecological zones and vegetation types. Dense, uniform vegetation conditions resulting from long-term fire exclusion are especially the case of Jeffrey pine and dry mixed conifer forests (Steel, Safford, and Viers 2015). In red fir forests, there has been only a marginal change in fire severity patterns over the last few decades (Meyer 2013a). In sagebrush and pinyon-juniper there has been a more complex change dependent on ecosystem type and rates on nonnative grass invasion (Slaton and Stone 2015a, 2015b). For example, cheatgrass invasion has led to more frequent and larger fires than historically. Conversely, fire suppression has resulted in an ingrowth of conifers (pinyon pine and Jeffrey pine) into sagebrush areas. Now, when sagebrush areas burn, they burn hotter because of the conifers.

Table 37. Summary of current condition of fire regime integrity by vegetation type in the Inyo National Forest

Vegetation Type	Current Condition Fire Regime Integrity
Sagebrush and Pinyon-juniper	moderate
Jeffrey pine and dry mixed conifer	low
Mountain mahogany	moderate
Xeric shrub/blackbrush)	moderate
Red fir and lodgepole pine	moderate
Subalpine and Alpine	high

Carbon Stocks, Sequestration, and Stability

The mixed conifer and eastside pine areas have low carbon stability because vegetation is dense and it is at a high risk of high-intensity fire (see “Fire Trends” and “Fire Management” sections and the Carbon Supplemental Report). Subalpine, alpine, sagebrush, and pinyon-juniper landscapes have moderate carbon stability. They have less standing carbon and have a moderate to low risk of high-intensity fire. Red fir and lodgepole pine forests have low to moderate carbon stability. At the lower elevations in this zone, forest density and fire risk conditions are similar to forests in the Sierra Nevada montane zone and carbon stability is low. At higher elevations, near subalpine areas and on rockier sites within the upper montane zone, the carbon stability is moderate because fire risk is moderate.

Most of the landscape area on the eastside is dominated by non-forest vegetation, primarily sagebrush. In these areas, soil and belowground carbon are important (the stability of this carbon is described in the Assessment reports; (USDA Forest Service 2013a, 2013b, 2013c). Restoration of degraded arid shrublands and woodlands can also enhance carbon stocks and sequestration, including areas invaded by invasive grasses (Finch 2012). These restoration approaches may increase belowground carbon storage, especially in deep-rooted shrub and perennial grass species, and increase the resilience of arid ecosystems to future stressors. This increase in resilience supports a greater long-term carbon carrying capacity and provides for improved carbon stability in arid landscapes.

Landscape Connectivity

Landscape connectivity is moderate to high in all areas except at lower elevations in sagebrush. Connectivity is low to moderate in sagebrush landscapes because of the invasion of conifers and areas of large high-intensity fire where cheatgrass has invaded.

Important Seral Stages

Old Forests

Old forests in the analysis area include legacy forest ecosystems in the Sierra Nevada montane zone, which includes the eastern escarpment of the Sierra Nevada and associated montane ecosystems in the Glass Mountains. Old forests in the area include mature stands that share the presence of large, old trees, for their species and site productivity (Franklin and Fites-Kaufman 1996, North et al. 2004). The density of large old trees, size, arrangement, and density of the forests they are embedded in varies by ecosystem type. For example, old Jeffrey pine forests often have trees that are several hundred years old that are variable in density and open and scattered in distribution. Old forests may also contain large snags and logs in various stages of decay, but densities of these structures can vary greatly with some stands lacking these elements. Historic stand inventories also indicate that many current old forest stands have experienced increases in snag and log densities associated with increased tree densities (Safford and Stevens 2017) and increased tree mortality rates, especially in larger diameter trees located in denser stands (Ritchie, Wing, and Hamilton 2008; Allen, Breshears, and McDowell 2015).

The condition and amount of old forest is low to moderate in the Sierra Nevada montane zone. These areas were most impacted by preferential logging of large and old trees during European settlement and more recent forestry practices up until the early 1990s (See “Forest Products” section and Vegetation Ecology supplemental report). Large trees have been killed by large, high-intensity fires (such as the 2002 McNally Fire on the Inyo and Sequoia National Forests), and stress-related factors (Van Mantgem et al. 2009). More recently, many trees are dying throughout montane forests on the Inyo National Forest due to ongoing drought, increasing temperatures associated with climate change, and related insect outbreaks (see the “Insects and Pathogens” section).

Complex Early Seral Forests

Complex early seral forests apply to actively managed forests in the Sierra Nevada montane zone, including dry mixed conifer, Jeffery pine, lodgepole pine, and red fir ecosystem types. However, Sierra Nevada dry mixed conifer and yellow pine (Jeffrey pine) forests are generally the forest types that experience most post-fire management activities and associated research studies in the plan area and bioregion (Knapp and Ritchie 2016, Long, Quinn-Davidson, and Skinner 2014c). Early successional forests following stand-replacing events (such as high-severity fire) within the natural range of variation represent an important ecological stage that supports diverse ecological processes, ecological communities, and structures (Swanson et al. 2010). The concept of complex early seral forests is based on ecological function and not just the age of the vegetation. This habitat type is created by stand-replacing disturbance events, including fires, insects, and wind throw. These disturbance events create clumps, patches, or larger areas of early successional (young) forest where overstory trees are temporarily absent or rare. Consequently, this forest successional stage represents a transitory period immediately following a stand-replacement event and prior to the ensuing period of forest development and canopy reestablishment.

Complex early seral forest is a type of early successional forest that contains structural, compositional, or functional elements of ecological complexity or integrity. This complexity and integrity in early seral forests often comes from the presence of elements created by the disturbance, such as snags, logs, isolated live trees (or tree clumps), young shrubs, herbaceous plants, regenerating trees, and sprouting hardwoods. Spatial heterogeneity (variation) in vegetation composition and structure during recovery after a disturbance is another important element of complexity in early seral forest (Swanson et al. 2010). Legacy structures following a disturbance like fire (such as large snags and logs, resprouting plants, and understory plant diversity) can provide habitat for early-successional-associated wildlife species and fire-dependent plants.

Complex early seral forests (such as those derived from high severity fire) provide a number of benefits when these stand-replacing patches fall within the natural range of variation. This includes habitat for early successional plant and animal species (Betts et al. 2010, Swanson et al. 2010, Fontaine and Kennedy 2012, Tingley et al. 2014), increased plant-pollinator interactions (Ponisio et al. 2016), and structural heterogeneity (Kane et al. 2013). In burned forest landscapes, a mosaic of low, moderate, and high severity patches interspersed with unburned refugia are characterized by high pyrodiversity (high diversity of fire effects across the landscape based on fire frequency, severity, and extent) that increases the diversity of plants and animals (Ponisio et al. 2016, Tingley et al. 2016). Patches of early successional forests within this mosaic may increase forest landscapes resilience by promoting tree regeneration and colonizing species, such as early successional mycorrhizae, nitrogen-fixing plant species, and keystone species associated with early successional habitats (such as pollinators, cavity excavators; Swanson et al. 2010; White et al. 2016; Saracco, Siegel, and Wilkerson 2011; Siegel et al. 2015). Early successional patches may also increase tree regeneration and recruitment for disturbance-dependent species such as aspen or giant sequoia (Krasnow and Stephens 2015, Meyer and Safford 2011, Piirto and Rogers 2002).

Post-fire management activities may reduce or increase structural complexity in early seral vegetation, depending on a variety of factors, including the specific management activity, forest type, ecosystem characteristics (such as fuels, habitat features, plant diversity, and composition), disturbance history, and extent and severity of fire (Long, Quinn-Davidson, and Skinner 2014c). Salvage and reforestation removes some structural elements such as snags and logs, or creates conditions that may not provide the same level of complexity or habitat quality for associated species (Swanson et al. 2010, Noss et al. 2006). Some habitat elements like pine snags often have limited longevity regardless of the level of management after a fire, such as salvage logging (Ritchie, Knapp, and Skinner 2013). In addition, the effects of post-fire management (salvage and reforestation) on early seral forest is dependent on the intensity and type of activities, such as snag and surface fuel retention levels (Ritchie, Knapp, and Skinner 2013). The effects of post-fire salvage and other management treatments on understory diversity, tree regeneration, and plant community composition are variable, with most studies indicating little to no differences in understory diversity and composition between treated and untreated stands (Knapp and Ritchie 2016, McGinnis et al. 2010) or increases in understory diversity following shrub removal associated with reforestation (Bohlman, North, and Safford 2016). The effects of post-fire salvage on woody fuels is also variable, with some studies indicating no differences between salvaged and unsalvaged areas (McGinnis et al. 2010), and other studies documenting a reduction in woody surface fuels several decades post-fire (Peterson, Dodson, and Harrod 2015).

Post-fire management activities, such as salvage logging combined with planting, can significantly increase post-fire tree regeneration in moderate to large high-severity patches that are lacking natural regeneration, which can enhance long-term structural complexity and forest integrity in these managed areas (Collins and Roller 2013; Welch, Safford, and Young 2016). Additionally, areas lacking post-fire management may convert to a shrub-dominated ecosystem following a reburn event due to elevated fuel levels associated with dense snags and shrubs (Coppoletta, Merriam, and Collins 2016; Harris and Taylor 2017) and the interactive effects of climate change and fire (Tepley et al. 2017). Similarly, selective post-fire management actions that target high valued areas of high fuel loading following high severity fire may effectively mitigate the impacts of future uncharacteristic fires and enhance the resilience to future wildfire events (Coppoletta, Merriam, and Collins 2016).

There is clear evidence of more high-severity fire now compared to historic conditions, specifically within yellow pine forests, including Jeffrey pine forests (Mallek et al. 2013, Safford and Stevens 2017). This is partially a consequence of increased fuel loading associated with long-term fire exclusion in these forests (Steel, Safford, and Viers 2015). Even more evident is the lack of low- to moderate-severity fire in nearly all forest ecosystems of the Sierra Nevada compared to the pre-European settlement period (Mallek et al. 2013). Importantly, the amount and proportion of complex early seral forest on the Inyo National Forest is very likely much higher than occurred historically, because there is a surplus of high-severity fire in yellow pine forests in the Sierra Nevada (Mallek et al. 2013), resulting in a surplus of early seral forests in Jeffrey pine forests of the Inyo National Forest (see Southern Sierra Nevada Wildfire Risk Assessment: Vegetation Condition Assessment Report), and a very low degree (about 0 to 1 percent between 1984-2014) of post-fire salvage and reforestation treatments in burned forests on the Inyo National Forest (see Complex Early Seral Forest Supplemental Report). Moreover, while there are larger patches of high-severity fire in current yellow pine and mixed conifer forests than under the natural range of variation (Safford and Stevens 2017), high-severity fire patch size remains relatively unchanged in most upper elevation forests with some exceptions (Meyer 2015b, Meyer 2015c).

Where fire regimes have been partially or wholly restored with prescribed fire or wildfires managed to meet resource objectives, it tends to result in more desirable fire effects dominated by patches of low- to moderate-severity fire (the exception are patches previously burned at high severity). While there is some uncertainty as to exactly how much high-severity fire occurred historically in montane forests, most evidence indicates this to be a smaller proportion of the burned area in these forest types (Safford and Stevens 2017). Moreover, it is also likely that high-severity fire patch sizes have increased considerably within these forests over the past few decades (Miller and Safford 2012, Westerling and Keyser 2016b). Historically, these high-severity patches were smaller in size and patchily distributed (not interconnected), resulting from mortality of individual, clumped, or small groups of trees. However, in recent years, Sierra Nevada dry mixed conifer and Jeffrey pine forest types have had large patches of high-severity fire resulting in substantially larger and more interconnected patches of complex early seral forest.

Keystone Species Groups

The current condition of pollinators and cavity excavators (such as woodpeckers) is uncertain, and there is little direct information available. For pollinators, forests with dense vegetation conditions lacking characteristic fire have lower levels of flowering understory plants, especially those dependent on higher light environments (Webster and Halpern 2010, Wayman and North 2007). These conditions are common for the majority of the montane forest areas (see “Terrestrial Vegetation Ecology” section). Restoration treatments, especially prescribed fire, increase the diversity of native pollinators, such as butterflies (Huntzinger 2003). Canopy arthropods also benefit from ecological restoration treatments, if the treatments also enhance tree, shrub, and herbaceous plant diversity within forest stands (Rambo, Schowalter, and North 2014). Invasive, nonnative plants can reduce pollinator habitat, especially if the nonnative plants are wind pollinated grasses such as cheatgrass. Large areas in the foothill zone and eastside lower elevation areas have had cheatgrass and other nonnative annual grass invasions. Pollinator habitat is greatly reduced in these areas.

Habitat for cavity excavators (especially snags) is highly varied. In conifer forests, the average number of snags in an area are within the lower end of the desired conditions but are highly variable spatially and often within or above the natural range of variation (Safford et al. 2013c, Meyer et al. 2014a). This high spatial variability means that there are many areas that have no snags and other areas that have more than the average number. Overall, large snag levels, especially very large snags (greater than 30 inches in diameter) may be limited in the forest landscape, especially within plantations (plantations cover only about 1 percent of montane forest vegetation or 0.2 percent of all vegetation on the Inyo National Forest), the wildland-urban intermix, and areas impacted by windstorms.

Tribal Uses and Biocultural Diversity

As mentioned previously, people of various Tribes in the area are and have been tied to different ecosystems across the bio-region that provide basic life needs of food, shelter, and culture (see “Tribal Relations and Uses” section). This includes gathering and tending trees such as black oaks and pinyon pines for primary food sources, medicinal plants, basketry and shelter from plants, fish and game harvest (Anderson and Moratto 1996, Anderson 2006), and culturally important activities including cross-Sierra travel and trade trips, and sacred ceremonies.

There was (and to a lesser degree currently is) an interaction between Native American land uses and management and ecosystem condition and function. Native Americans often used fire or other means to improve basketry or food materials, to improve habitat conditions for game species such as deer, and to maintain meadow ecosystems. This use of fire included riparian areas, because a high proportion of plants that are important for basket weaving occur there.

On the east side of the Sierra Nevada, seed, root, and bulb gathering occurred, and in some cases, irrigation was used to encourage desirable species (Slaton and Stone 2015a and 2015b). Activity in sagebrush was concentrated near meadows. Fire was conducted in the spring and fall. The Paiute, Shoshone and Washoe used pinyon pine extensively and still collect products from the trees, including pine nuts, pitch, and wood products. Native Americans pruned the trees, raked away the litter, weeded around them, and burned to increase productivity and protect them from wildfire. Elder interviews attest to the fact that fire was used to foster growth of particular food groups such as wild onions, elderberries, and caterpillars. Fire was used to eliminate excess fuels that threatened favorite pinyon pine stands.

The condition of plants, animals, and insects that Tribes use, as well as the ecosystems they occur in, is low for low- and mid-elevation areas (montane, eastside pine, and sagebrush vegetation types) and moderate for higher elevation areas (red fir forest, lodgepole pine forest, subalpine forest, and alpine vegetation types). This is related to the condition of vegetation and fire regimes relative to the natural range of variation. Dense vegetation, and limited low- and moderate-intensity fire are primary factors. Current vegetation conditions are denser and less diverse in the understory, and many important plants such as black oak, shrubs used for basketry, and other plants used for traditional foods or medicines are in poor condition. Traditional travel routes are covered in dense vegetation, impeding ease of travel, particularly for elders and young tribal members. Management for biodiversity, particularly through the use of beneficial fire, would help to maintain viable populations of the diverse plants and animals that are necessary for Native American traditionalists to continue their cultural practices.

Integrated Terrestrial Ecosystem Sustainability

The integrated terrestrial sustainability condition varies by the ecological and elevational zone. For details by each zone and major vegetation type, see the “Fire Trends,” “Terrestrial Vegetation Ecology,” and “Insects and Pathogens” sections. Here a synthesis of the overall findings from each of these sections is presented.

In most lower and mid-elevation areas, indicators of terrestrial ecosystem sustainability point to a low and moderate condition as shown in table 38 (USDA Forest Service 2004a, 2011f). The greatest contributors are vegetation and fire conditions that are outside of the natural range. At lower elevations of the Inyo National Forest, invasive plants are widespread, although still scattered in many locations. The ecosystems are still functioning but may be at a tipping point for large change. This would include a higher susceptibility to widespread drought and insect- and pathogen-related plant and tree mortality. It includes a susceptibility to widespread changes in connectivity, forest cover, and mature forest area from increasingly large, high-intensity fires.

Environmental Consequences to Terrestrial Ecosystem Processes and Functions

Consequences Common to All Alternatives

Fire Regimes and Fire as an Ecological Process

Fire regimes would continue to be departed from the natural range of variation for much of the mid- and lower elevation areas in the analysis area, except where moderate to high levels of restoration occur across broader areas. Because fire operates at large scales, landscapes (areas greater than 10,000 acres) with at least 40 to 60 percent restoration are necessary to effect changes in large fire patterns (the amount of high-intensity or crown fire; see the “Fire Trends” section). The alternatives vary in the amount of the landscape that would have restoration of varied types (such as mechanical treatments, prescribed fire, or wildfire managed to meet resource objectives). The alternatives also vary in the intensity of the treatments, or degree of change in vegetation that affects fire type. Finally, the alternatives vary in the amount of fire that would be applied or managed on the landscape at intensities within the desired condition that would have beneficial effects to the vegetation, and would reduce fire regime interval departure.

Table 38. Overall ecosystem sustainability conditions by characteristic from National Forest Sustainability Report* by major vegetation types for the Inyo National Forest

Characteristic	Sagebrush/ pinyon-juniper	Jeffrey pine and dry mixed conifer	Red fir and lodgepole pine	Xeric shrub/ blackbrush and mountain mahogany	Subalpine/ alpine
Area affected by insects and pathogens beyond background levels	Current, low to moderate susceptibility moderate	Current moderate, susceptibility high	Current moderate, susceptibility moderate	low	Low
Area affected by air pollutants that may cause negative effects	Low, but some transport of ozone east of the San Joaquin River drainage	Low, but some transport of ozone east of the San Joaquin River drainage	Low, but some transport of ozone east of the San Joaquin River drainage	low	Moderate to low
Area affected by invasive species	Moderate, extensive areas of nonnative grasses	moderate	low	moderate	Low
Area with fire condition class outside of natural range	moderate	high	moderate	moderate	Low
Area with vegetation condition outside of natural range	moderate	high	moderate	Low	Low

* USDA FS 2004, USDA FS 2011

In this section, the broader characterizations of the alternatives are described by the vegetation type actions would most likely occur in. The majority of the mechanical and prescribed fire restoration treatments are most likely to occur in the pinyon-juniper and Jeffrey pine woodlands on the east side. Wildfire managed to meet resource objectives is most likely to occur in the the Kern River drainage and some other montane forest areas. Large areas of montane, mixed conifer forests and chaparral are highly likely to have fire managed to meet resource objectives. The greater amounts of mechanical treatments in alternatives B and D in strategic locations would increase the likelihood of larger prescribed fires and managed fires to meet resource objectives in montane areas. These characterizations by vegetation type are used to analyze the expected consequences of the alternatives below.

Table 39 summarizes the expected consequences of the alternatives by major vegetation type. In all alternatives, there is little difference among the alternatives in consequences to the subalpine and alpine areas. Limited vegetation and harsh growing conditions result in slow changes in vegetation there. The majority of these areas are in wilderness or inaccessible locations.

Table 39. Fire regime integrity for vegetation types by alternative

Vegetation Type	Alternative A	Alternatives B and B-modified	Alternative C	Alternative D
Sagebrush	Moderate	Moderate to high	Moderate to high	Moderate to high
Pinyon-juniper	Moderate	Moderate to high	Moderate to high	Moderate to high
Jeffrey pine	Very low	Low to moderate	Low	Moderate
Dry mixed conifer	Low	Low to moderate	Low	Moderate
Mountain mahogany	Moderate	Moderate to high	Moderate to high	Moderate to high
Xeric shrub/black brush	Moderate	Moderate to high	Moderate to high	Moderate to high
Red fir and Lodgepole Pine	Moderate	Moderate to high	Moderate	Moderate to high
Subalpine and Alpine	High	High	High	High

Sierra Nevada Montane Zone

In all alternatives, red fir and lodgepole pine forests have at least moderate integrity owing to the relatively longer fire return intervals in these forest types (median fire return interval of approximately 30 to 50 years). However, most red fir and lodgepole pine forests have missed one or two fire return intervals, resulting in a variety of ecological impacts associated with fire exclusion (such as increased fuel loading and tree densities). Red fir is among the most vulnerable to climate change (North 2014, Meyer et al. 2014a). This is because they are experiencing and will continue to experience the greatest relative change in type of precipitation and temperatures. Fires may become more frequent in red fir forests and disrupt the current moderate levels of fire regime integrity and resilience.

Current Jeffrey pine and dry mixed conifer forests in the Sierra Nevada are moderately to highly departed from their historic fire regimes, because of decades of fire exclusion in these frequent fire-regime forests. Under all alternatives, fire regimes in Jeffrey pine forests would be relatively intact on the Kern Plateau, owing to the many wildfires that are managed to meet resource objectives in this portion of the Inyo Forest.

Subalpine and Alpine Zone

Alpine vegetation and many subalpine forests at higher elevations would have high fire regime integrity under all alternatives, because of the very long historic fire return intervals in these vegetation types that often exceed 150 to 200 years. This is greater than the current fire exclusion period of the 20th and early 21st centuries. As a result, they are within the natural range of variation with respect to fuel loading and fire regimes. All alternatives support at least moderately high resilience to fire.

Eastside Shrublands and Woodlands

Although highly variable, the historic fire return intervals were relatively long in sagebrush (40 to 450 years), pinyon-juniper woodlands (90 to 150 years), curl-leaf mountain mahogany (60 to 70 years), and xeric shrub and blackbrush (more than 600 years). Under all alternatives, arid shrublands and woodlands would have at least moderate fire regime integrity, owing to the relatively long fire return intervals in these arid vegetation types. However, increasing and excessive wildfire activity in these vegetation types that exceed the natural range of variation (that is, too frequent fire compared to the historic fire regime) would result in reduced fire regime integrity. This reduced integrity is often associated with vegetation type conversion favoring nonnative annual grasses such as cheatgrass and red brome.

Ecological restoration treatments in some eastside shrublands and woodlands (like sagebrush invaded by pinyon pine), could increase the resilience of these ecosystems to wildfires and reduce the probability of excessively frequent fire that exceeds the natural range of variation. However, all alternatives would support at least moderate fire regime integrity in many arid shrublands and woodlands (such as xeric shrub and blackbrush), because of the long historic fire return intervals in these vegetation types that often exceed 100 to 200 years. This is greater than the current fire exclusion period of the 20th and early 21st centuries.

Carbon Stocks, Sequestration, and Stability

Under all alternatives, there would be several conditions and trends that greatly influence current carbon stocks, sequestration, and especially stability. First, dense forests would continue to occur across much of the area, because there are no alternatives that restore more than 50 percent of most landscapes. This means that carbon storage and sequestration will continue in those areas. There may be increases in carbon sequestration in thinned forests, since individual trees would be less stressed and may have faster growth. At the same time, under all alternatives, there would continue to be large, high-intensity fires, especially within dense forests lacking restoration. When these fires occur, there will be large conversions of carbon stored in forests and soil litter, into carbon dioxide in the air. Climate change will also limit carbon sequestration and carbon stocks following these fires through increased evaporative demand that limits tree growth rates and regeneration.

Tribal Uses and Biocultural Diversity

There would be continued use of forest lands, vegetation, insect, and animal materials by Tribes in all alternatives, similar to what occur now. More information on how these are determined and negotiated is covered in the later section on “Tribal Relations and Uses.” The condition of ecosystems, plants, insects, and animals used by Tribes varies by alternatives. In addition, all but alternative A contains specific direction that would improve the condition and use by tribal members. The rate and type of ecological restoration that would result in improvements varies by alternative.

Consequences Specific to Alternative A

Fire Regimes and Fire as an Ecological Process

Sierra Nevada Montane Zone

Fire regime integrity would continue to be low in montane forests in alternative A. This analysis assumes that a low amount of any type of treatment would occur in alternative A. It also assumes that most of the restoration treatments would result in limited to moderate changes in vegetation structure and composition that would influence fire type, fire severity, and effects. Most of the treatments would occur in montane mixed conifer vegetation. Fire regime integrity would continue to be low across most areas, with high proportions of crown fire and fire severity expected during peak fire season fires. The trend of increased fire severity would continue or worsen due to increased burned area and fire size (see the “Climate Change” and “Fire Trends” section).

There is expected to be some restoration of wildfires used primarily to meet resource objectives but little to none of this would occur in montane forests except for in the Kern Plateau on the Inyo National Forest. Large areas in the Kern Plateau have already had managed fire (greater than 30 percent) and would continue to in alternative A. Fire regime integrity would continue as moderate or shift to high in some of this area.

Beneficial effects of fire to understory flora would be limited because prescribed fires would be limited. Some plants and birds would benefit from large, higher severity fires, but overall, a deficit of low- and moderate-severity, frequent fire would have the most beneficial effects. This latter type of fire would be limited in alternative A.

Subalpine and Alpine Zone

Alternative A would support continued moderate to high fire regime integrity in subalpine forests as described under all alternatives. There would be limited restoration treatments in these areas. Similar to montane forests, there would continue to be some ecologically beneficial fires, especially in wilderness and in the Kern River drainage.

Eastside Shrublands and Woodlands

The least amount of restoration treatment would occur in alternative A in eastside shrubs and woodlands. There would be less restoration of sagebrush areas with conifer invasion, and in pinyon-juniper and Jeffrey pine forests. There would be less restoration of fire as an ecosystem process using prescribed fire. Invasive plant treatments would continue to minimize introductions of invasive species when possible, but invasive species would continue to expand and potentially alter fire regimes.

Carbon Stocks, Sequestration, and Stability

Low levels of vegetation restoration would continue in alternative A, while the likelihood of large, high-intensity fires would increase (see "Fire Trends" section; Westerling, Milostan, and Keyser. 2015). This would result in increased emissions of carbon to the atmosphere and decreases in carbon stocks and sequestration. Most of the carbon stocks and fires both occur in the montane zone. Therefore, an individual very large fire can have large impacts on carbon stocks and emissions. There would be a negative impact of alternative A on carbon stability, carbon stocks, and sequestration rates.

Landscape Connectivity

Alternative A would result in few indirect effects to landscape connectivity because treatment levels would be low. The primary consequence would be the effect of treatments in reducing the likelihood of large high-intensity fires that can disrupt connectivity for many species, except those using early seral habitat. The extent of restoration treatments is very low (less than 10 to 15 percent of the low and mid-elevation landscape area) and thus the likelihood of large, high-intensity fires would increase in alternative A (see "Fire Trends" section; Westerling, Milostan, and Keyser. 2015) and cause fragmentation of forested areas and areas of sagebrush habitat for species such as sage-grouse.

Important Seral Stages

Old Forest

The treatments in alternative A would have little to no impact on large trees and the proportion of area in old forest. There are diameter limits restricting the harvest of any trees greater than 30 inches in diameter under almost all conditions. Treatment area is limited in alternative A and there are also limitations on the forest canopy cover changes that can occur in montane forests or other areas where California spotted owl, Pacific fisher, or Sierra marten occur. This would result in a continuation of large areas of high forest density that are susceptible to high-intensity fires (see “Fire Trends” section and Fire Ecology supplemental report). There is an increased likelihood of large, high-intensity fires under current treatment levels (see “Fire Trends” section; Westerling, Milostan, and Keyser. 2015). Therefore, this analysis assumes there would be an increased likelihood of large, high-intensity fires in areas with old forests.

It is unknown what proportion of areas burned in future fires would be high severity and result in large tree mortality. Recent fires have ranged widely in large tree mortality levels and extent. Given the limited levels of current old forest and the long time it takes to redevelop (several hundred years), the impact of single, large, high-intensity fires may have negative impacts on old forests. The likelihood of very large “mega fires” (greater than 50,000 acres like the King Fire that had extensive areas burned in old forest in Rubicon River Canyon at extremely high intensity) is thought to be increasing because of climate warming, longer fire seasons, and drier fuel conditions (Millar and Stephenson 2015). It is unknown when or where these types of fires may occur, but the likelihood exists in the analysis area and the likelihood is increasing.

Complex Early Seral Forest

The impacts of alternative A on complex early seral forest are related to the consequences described above for old forest as well as likely salvage, reforestation, and other post-fire restoration treatments. The amount and distribution of complex early seral habitat would likely increase under alternative A because the amount of high-intensity fire is likely to increase and anticipated rates of post-fire salvage on the Inyo National Forest will remain near zero. The spatial pattern of the complex early seral forest would likely continue to be mostly in large patches from large high-intensity fires. The exception would be portions of the Kern River drainage, where extensive fire restoration in the last decade has resulted in a wide variety of small and medium size high-severity fire patches (Meyer 2015a). Fires are starting to burn into previously burned areas, limiting the potential in this area especially on the Kern Plateau to develop large high-severity fire patches (Vaillant 2009; Ewell, Reiner, and Williams 2012).

There is no specific management direction under alternative A directed at desired conditions, guidelines, or standards for complex early seral forest. There is direction to leave at least 10 percent of burned areas unsalvaged. However, the amount of salvaged or reforested burned area on the Inyo National Forest has been negligible to nonexistent due to the lack of local timber processing infrastructure, limited demand for timber products, and other reasons (such as accessibility). In the past three decades, approximately 0 percent and 1 percent of burned areas have been salvaged and reforested, respectively, on the Inyo National Forest (see Complex Early Seral Forest Supplemental Report). Therefore, currently the vast majority of burned areas on the Inyo National Forest are not treated and are left to provide these habitats. In addition, early seral forest is currently within or slightly exceeding the natural range of variation for montane forest vegetation types on the Inyo National Forest (see Vegetation Condition Assessment Supplemental Report). Future projected increases in wildfire severity and frequency, lower rates of forest restoration treatments, and the near absence of post-fire management activities on the Inyo National Forest in alternative A will likely result in an increase in complex early seral forest that exceeds the natural range of variation. This will especially be evident in montane forest landscapes exposed to repeated uncharacteristic wildfires.

Keystone Species Groups

Pollinators – Pollinators are positively impacted by restoration treatments that result in sunny openings and improve conditions on the forest floor. Many flowering plants benefit from fire, although in large fires where nonnative, invasive plants expand, they have an opposing impact. In alternative A, treatments would be very limited that benefit pollinators. There would be limited amounts of treatments that generally retain moderate and high canopy cover, and limited amounts of prescribed fire. Overall, alternative A would continue to maintain dense forest conditions, with limited fire restoration, that retains poor flowering plant conditions that pollinators depend on.

Primary Cavity Excavators – There would be increases in primary cavity exactor habitat because limited restoration would perpetuate dense forest conditions, which would continue to have trees dying and increasing snag levels. However, there is the potential that they can be harvested outside of wildland-urban intermix areas for fuel or hazard.

Tribal Uses and Biocultural Diversity

Alternative A has the least change in conditions of ecosystems, plants, insects and animals of interest to and used by Tribes than any of the other alternatives. Conditions would continue to be poor in most areas, with only limited areas where restoration improves them. There would be limited projects that specifically address tribal member concerns and incorporate some traditional ecological practices, but in a limited way.

Integrated Terrestrial Ecosystem Sustainability

With limited restoration levels, vegetation would continue to remain dense overall and outside the natural range of variation in most low and mid-elevation areas (see “Terrestrial Vegetation Ecology” section). There would continue to be a high susceptibility to insects, pathogens, and air pollution stress (on the west side especially).

Consequences Specific to Alternative B

Fire Regimes and Fire as an Ecosystem Process

Three types of restoration treatments would occur in alternative B that would move the landscape toward desired conditions for fire regimes and restoration of fire as an ecosystem process (TERR-FW-DC-06). The first are the vegetation restoration treatments (TERR-FW-OBJ-01 to 02), especially in large landscape areas as described in the management approaches below.

> During ecological restoration treatments, reduce fuels along ridges, roads, or other natural or man-made features to aid in the use of large prescribed fires and in managing wildfire, including wildfires managed primarily for resource objectives.
>
> Develop landscape scale projects to increase the pace and scale of ecological restoration, ecosystem resilience and fire resilience, and to protect the carbon carrying capacity of the forest.
>
> Plan vegetation, fuels, and other restoration projects across large landscape areas (e.g., greater than 5,000 to 10,000 acres), when it can increase efficiency in planning and support partnership-based approaches, such as stewardship contracts.

Mechanical treatments and prescribed fire would result in restoration of fire as a process in these areas and increase the likelihood that when large wildfires move through these areas, fire severity would be mixed or lower than adjacent unrestored areas (TERR-FW-OBJ-02, FIRE-FW-DC-01, FIRE-FW-GOAL-03). Vegetation restoration along ridges and some roads (MA-GWPZ-GDL-01) would increase the likelihood that large prescribed fires could be used to restore fire to landscape areas, especially where there is steep and inaccessible terrain. In alternative B, restoration along ridges and roads would occur mostly in the Sierra Nevada montane zone.

At higher elevations in the montane and subalpine areas or in the Kern River drainage, there would be additional restoration emphasizing wildfire managed to meet resource objectives (MA-WRZ-GOAL-01; MA-WRZ-DC-01 to 03; MA-WMZ-STD-01 to 02). There would be less restoration along ridges and roads because there are more natural features (like rock outcrops along ridges) and recent fires to use as fire management boundaries (MA-WRZ-STD-01). There would also be localized restoration of fire as part of restoring areas of tribal importance (TERR-FW-DC-11).

Additional specific management direction to restore fire as an ecological process is specific to individual vegetation types with associated consequences as described below.

Sierra Nevada Montane Zone

There would be an increase in fire regime integrity in alternative B, because more treatments are focused in the Jeffrey pine and dry mixed conifer forests of the montane zone. This is because there is an emphasis on restoration objectives of montane and other ecosystems that historically had frequent fire and on management approaches prioritizing restoration in these areas (see below).

> Areas that historically supported more frequent fire, like Jeffrey pine-dominated forests, and areas with high existing levels of understory fuels are prioritized for treatment.

There would be a moderate movement toward the desired fire regime in alternative B, primarily in the Kern drainage.

In the plan area, restoration to a lower forest density and fuel condition would decrease the likelihood that fires would be more severe (see “Terrestrial Vegetation Ecology” section). There would be fewer large areas of high-intensity fire, and instead fire effects would be more mixed severity (see “Fire Trends” section). There is a moderate level of uncertainty that these beneficial effects would occur because of restrictions on spring burning from air quality and other limitations. Where there is prescribed burning, there would be considerable beneficial effects on the plants and animals that benefit from fire. This would especially occur when there is restoration of sunny openings and heterogeneity coinciding with the burned areas. Many of the plants that are adapted to fire are also adapted to sunlight. In alternative B, there would be additional beneficial fire effects to plants and animals through increased emphasis on projects related to tribal interest.

Subalpine and Alpine Zone

The greater use of wildfire to meet resource objectives in alternative B, would increase the integrity of fire regimes in some subalpine forests. This is especially true in subalpine landscapes with relatively short fire return intervals (such as forests with spatially contiguous fuel loading, south-facing aspects, and at lower elevations).

Eastside Shrublands and Woodlands

Alternative B would have increased levels of restoration in sagebrush and pinyon-juniper areas (TERR-FW-OBJ-01 to 03; SPEC-SG-OBJ-01). The restoration would include removal of conifers in sagebrush areas and treatment aimed at reducing nonnative annual grasses (INV-FW-

OBJ-01). There would be some increases in prescribed fire. These restoration treatments would increase fire regime integrity and would improve habitat for greater sage-grouse. The fire-climate scenarios showed that restoration of 30 percent of the sagebrush and pinyon-juniper landscape was sufficient to decrease the likelihood of large fires and burned areas (Westerling, Milostan, and Keyser 2015). The combined effect of the ecological restoration and increased likelihood of large fires will be increased fire regime integrity.

There would be an increased emphasis on cooperation with Tribes and restoration of areas of tribal interest in alternative B. This would include some use of prescribed fire and also some restoration of areas of tribal interest that are at risk of high-intensity fire. These types of restoration would benefit plants, insects, and animals that are associated with natural fire regimes.

Carbon Stocks, Sequestration, and Stability

Under alternative B, there would be restoration treatments across substantial landscape areas (up to 30 percent or more). These treatments would move vegetation toward the desired conditions, increasing heterogeneity and reducing forest density. This would increase fire resilience and as a result of carbon stability (TERR-FW-DC-02, -07). There may be short-term decreases in carbon storage where trees are removed by thinning, but a long-term increase through increased carbon stability. There would be short-term increases in carbon emissions where there are prescribed fires or wildfires managed to meet resource objectives but these would be offset by reductions in potential high-intensity wildfire emissions (see “Air Quality” section). The impact of restoration on carbon sequestration is more uncertain. There may be increases because vegetation in the thinned areas may have more optimal growing conditions. There may be decreases because trees are removed.

Landscape Connectivity

The impacts of alternative B on connectivity would be similar to alternative A, but with a lower likelihood of fragmentation of forested areas from large high-intensity fires. There is management direction specifically directed at connectivity for wide-ranging species and climate-related migrations (TERR-FW-DC-06; TERR-OLD-DC-02; TERR-SAGE-DC-04; TERR-SAGE-GOAL-01b, TERR-CES-GOAL-01c; SPEC-CSO-DC-01). This includes management approaches to prioritize ecological restoration in areas providing connectivity in areas where it is limited for forest and sagebrush dependent species. This would provide connectivity for other species needing overhead cover. For example, TERR-SAGE-DC-04 (open sagebrush habitat with no overstory trees provides habitat connectivity for sagebrush-dependent species), SPEC-SG-DC-04 (sage-grouse habitat allows for population movement, seasonal movements, and genetic flow), and TERR-FW-DC-06 (the landscape contains a mosaic of vegetation types and structures that provide habitat, movement and connectivity for a variety of species) would provide short- and long-term habitat connectivity for sage-grouse in arid shrubland landscapes that may be impacted by conifer encroachment, altered fire regimes, and other stressors.

There would be lower likelihood of large high-intensity fires because of the increased area with restoration, especially at the mid-elevation areas (see “Fire Trends” section). The likelihood of large high-intensity fires would still increase because of climate warming, and these fires could result in fragmentation of forested areas. These fires could also increase connectivity of complex early seral habitat (see section in the following pages) but these habitats tend to be more dynamic in space and time limiting the need for true connectedness. There would be an increased emphasis in alternative B in restoration treatments in key habitat linkage areas for various species (such as sage-grouse or marten) that would decrease the likelihood of fragmentation of key north-south forest connecting areas. There would be an increase in connectivity of open forest habitat because the restoration treatments would be directed toward desired conditions for forest heterogeneity and reduced overall forest density.

Important Seral Stages

Old Forest

Eastside Old Forests: The consequences for eastside old forests would be based on management toward the desired conditions for large tree densities and landscape proportions of old forests. It is assumed that there would be very limited if any removal of large trees during restoration to achieve specific objectives (e.g., to protect and promote the health of even larger and older trees but not to mitigate wildfire risk). The same restrictions on removing trees greater than 30 inches in diameter in westside forests applies to eastside forests (TERR-FW-STD-01; table 40). Because of the drier conditions, it is more likely that old, medium-diameter trees (greater than 20 inches diameter) could be removed, but it is unlikely except under certain circumstances. Most thinning that does occur during restoration is used as fuelwood or for community protection. Restoration would result in increased resilience of old forests where it decreases forest density and increases heterogeneity. There would be limited amounts of restoration in alternative B but an increase over current levels (alternative A). There would be a slight increase in resilience. There would continue to be losses of large and old trees from drought, insects, pathogens, and climate change in unrestored areas.

Table 40. Plan direction on large tree densities by location in alternative B

Plan Direction	Inside Fire Protection Zones	Outside Fire Protection Zones
Large tree direction and consequences	Manage for desired densities	30-inch tree diameter limit, operational exception
Wildlife-related large tree direction	Retain and recruit den and nest trees, especially old and with decadence	same
Potential harvest of large trees, (safety issues, excess of desired conditions)	Limited, amount uncertain (similar to D)	Little to none (similar to A)
Potential loss of large trees to drought, insects, pathogens and fire	Low resilience (limited by canopy retention restrictions)	Low resilience, similar to A

Complex Early Seral Forests

There is specific management direction for complex early seral forests in alternative B including: desired conditions (TERR-CES-DC-01 to 03), goals (TERR-CES-GOAL-01-0), and guidelines (TERR-CES-GDL-01 to -05). This includes retaining at least 10 percent of large contiguous blocks (1,000 acres or more) of areas burned at moderate and high severity with high snag densities for complex early seral habitat that is unsalvaged (TERR-CES-GDL-05). Management approaches include:

> During post-fire restoration projects, consider the availability of complex early-seral forests across the Inyo and region to provide for ecological conditions needed by complex early seral wildlife species. This includes retaining areas of: dense, variable, and connected patches of snags across a range of snag sizes; naturally regenerating vegetation; adjacent or intermixed burned and unburned areas; or areas with moderate to high tree survival.

> Promote native vegetation (e.g., conifers, aspen, shrubs) in complex early-seral habitat that supports long term ecosystem integrity considering climate change, drought, insects, disease and fire.

Alternative B would result in some changes in the spatial pattern and amount of complex early seral forest. There would be some shift toward a fine-grained, mosaic of complex early seral forest, especially in forests that have burned in the last 15 years. Restoration aimed at increased forest heterogeneity would increase the likelihood of increased heterogeneity during fires of all kinds. Prescribed fires and wildfires managed to meet resource objectives, and desired conditions for fire severity mosaics (TERR-MONT-DC-02) would result in increased area with very small (less than 1 acre), small (1 to 10 acres) and medium to large (10 to 200 acre) patches of mixed- and moderate-severity fires that would contribute to complex early seral habitat. Wildfires managed for resource objectives typically have high spatial complexity (Vaillant 2009); (Meyer 2015a). The guideline to retain at least 10 percent of areas burned at moderate and high severity unsalvaged would provide for complex early seral habitats.

In the past 30 years, salvage of dead trees has been virtually absent in burned areas on the Inyo National Forest. Artificial reforestation would occur in some very limited areas (about 1 percent of the burned area on the Inyo National Forest), and it is often limited in scope and area to locations where it is safe and relatively accessible for workers and feasible to prepare mineral soil seedbeds for planting trees. There would be increased consideration of natural regeneration in some areas burned in extensive large patches of high-severity fire, where there are insufficient living seed trees to ensure enough seedlings will regenerate a forest. These changes, compared to current management, would result in an increased proportion of large, high-intensity fires that would provide large areas of complex early seral forest. In addition, early seral forest is currently within or slightly exceeding the natural range of variation for montane forest vegetation types on the Inyo National Forest (see Vegetation Condition Assessment Supplemental Report). Although projected future increases in uncharacteristic wildfire will increase proportions of complex early seral forest in the Sierra Nevada montane zone, increased restoration treatments rates in this zone for alternative B would likely mitigate this trend of increasing wildfire severity. This will bring the proportion of complex early seral forest closer to the natural range of variation despite future increases in wildfire severity and frequency.

Keystone Species Groups

Pollinators – In alternative B, there would be increased levels of restoration toward vegetation desired conditions, including increased heterogeneity that would benefit pollinator plants (TERR-MONT-DC-01). There would be an emphasis on restoration toward desired conditions of vegetation that are based primarily on the natural range of variation. Restoration of native plants would support restoration of dependent pollinators. This would provide more openings and sunlight to the forest floor that would improve pollinator habitat. There would be more prescribed fire and wildfire managed to meet resource objectives that would improve conditions for fire-associated flowering plants (see “Fire Management” section).

In eastside shrublands and woodlands, restoration activities under alternative B would also improve pollinator habitat. Increased levels of restoration in sagebrush and pinyon-juniper are expected to generally favor annual flowering plants over perennials. This would potentially benefit some pollinators during spring blooms, but provide less benefit to pollinators dependent on greater canopy cover or on late-seral, summer perennials such as species of penstemon or mule ears. Benefits to pollinators would be highly dependent upon effective control of invasive species. Invasive, nonnative annual grasses and other nonnative plants displace native plants and their associated pollinators. Restoration treatments in these vegetation types would be especially effective at enhancing pollinator habitat when treatments also minimize invasive plant spread.

Cavity Excavators – There may be an increase in the amount of snags because snag retention levels would be higher than currently (alternative A) in most areas (TERR-DMC-DC-06; TERR-RFIR-DC-07; TERR-LDGP-DC-06, 10) except in the community buffer areas (MA-CWPZ-GDL-01b) in the community fire protection zone. There would be an increase in the diversity of plant communities or habitats that snags occur in because of increased restoration of vegetation into more heterogeneous conditions and retention of large trees with deformities and cavities for wildlife habitat (TERR-FW-GDL-01; TERR-OLD-GDL-01). This would result in an increase in the diversity of cavity excavator habitat (TERR-FW-GDL-02). There would be an increase in the amount of open and moderately open forests in the pine and mixed conifer forests. There would be an increase in the amount of snags in small patches of burned forest because of the increase in prescribed fire and wildfire managed to meet resource objectives. This would increase habitat for cavity excavators and other species that rely upon intermixed or adjacent burned and green habitat. There would be increased snag retention levels and direction for complex early seral habitat that would provide more snag habitat in forests burned at high severity, including in areas of large stand-replacing bark beetle mortality events (TERR-CES-GOAL-01d; TERR-CES-GDL-02; see “Complex Early Seral Forests” section above).

Tribal Uses and Biocultural Diversity

In alternative B there is specific direction to improve conditions for plants and vegetation of tribal interest (TERR-FW-DC-11; TERR-OAK-DC-01) and restore areas of tribal importance (TERR-FW-OBJ-03). There also would be a moderate level of restoration of ecosystem, plant, insect, and animal conditions (see “Terrestrial Vegetation Ecology” section). Areas restored with mechanical thinning and prescribed fire together would result in improved conditions for plants and animals of tribal interest (Lake and Long 2014a). This includes overcrowded black oaks, insect resources associated with eastside Jeffrey pine forests (Pandora moth), and shaded understory shrubs and plants currently growing in dense conifer forests (Merriam et al. 2013, Safford and Stevens 2017).

Areas with prescribed fire and fire managed to meet resource objectives would improve conditions for all understory plants (TERR-MONT-DC-02; TERR-DMC-DC-02; TERR-JEFF-DC-02; TERR-RFIR-DC-02; TERR-LDGP-DC-02) including those used for food, basketry, and medicine (Anderson and Moratto 1996, Anderson 2006). Large landscape areas treated would improve conditions for bear, deer, and other important wide-ranging species (TERR-FW-DC-06). Alternative B would have an increase in fire managed to meet resource objectives, particularly at middle and higher elevations that would have benefits to large ecosystem areas. The ecological restoration projects specifically planned and coordinated with Tribes would incorporate traditional ecological knowledge and practices and be focused on sites selected by tribal members (TERR-FW-GOA L-01; TRIB-FW-DC-01).

Integrated Terrestrial Ecosystem Sustainability

Alternative B would result in increased integrated sustainability. The greater amount of the landscape area that would be restored under this alternative would increase the resilience of terrestrial ecosystems to uncharacteristic fire, insects, diseases, air pollution, or climate change. Sustainability would be most improved in terrestrial ecosystems targeted by restoration efforts, including in montane forest ecosystems and sagebrush ecosystems.

Consequences Specific to Alternative B-modified

The consequences of alternative B-modified would be similar to alternative B, but there would be a slightly higher forest restoration treatment rate under alternative B-modified from mechanical thinning and wildfires managed to meet resource objectives. This slight increase in forest restoration rates (specifically the increase in wildfires managed to meet resource objectives) in alternative B-modified would marginally increase the level of fire regime restoration, carbon sequestration and stocks, landscape connectivity, ecological representation of important seral stages (such as old forest and complex early seral), habitat for keystone species (pollinators, cavity excavators), biocultural diversity and tribal interests, and integrated terrestrial ecosystem sustainability. This would be particularly evident for those terrestrial ecosystem processes and functions associated with forest ecosystems (carbon stocks, cavity excavators, and forest connectivity) that will experience marginal increases in restoration treatment rates in alternative B-modified. Increased rates of mechanical thinning in alternative B-modified compared to alternative B would increase some elements of ecosystem integrity, such as carbon sequestration and stocks.

Compared to alternative B, about 133,490 acres in alternative B-modified would be reclassified from the Maintenance or Restoration Fire Management Zone to the General Wildfire Protection Zone. Nearly all of these acres are located in lower elevations of the sagebrush vegetation type, where the primary restoration approaches would rely on methods other than wildfires managed to achieve resource objectives (such as prescribed burning or mechanical thinning of encroaching conifers). Although, this fire management zone reclassification will not result in changes to sagebrush treatment rates, it will result in fewer wildfires burning in this vegetation type in areas with potential for fire-facilitated cheatgrass invasion. This additional protection from wildfire-facilitated cheatgrass invasion in alternative B-modified would result in slightly higher levels of fire regime restoration, carbon sequestration and stocks, landscape connectivity, habitat for pollinators, biocultural diversity and tribal interests, and integrated terrestrial ecosystem sustainability in alternative B-modified compared to alternative B.

Consequences Specific to Alternative C

Fire Regimes and Fire as an Ecosystem Process

Overall, there is an emphasis on fire as a restoration tool in Alternative C that would increase the use of fire as an ecosystem process. However, there is a higher level of uncertainty about how much prescribed fire would occur because there would be fewer associated mechanical treatments along ridges and roads that would prepare areas for conducting large prescribed fires. Similarly, although there is the intent to manage more wildfires to meet resource objectives, there may be fewer opportunities because there would be fewer areas treated mechanically and with prescribed fire that could assist with better management of those fires.

Sierra Nevada Montane Zone

Overall, lower levels of treatments are proposed for alternative C in montane forests. Alternative C would have lower levels of fire restoration (prescribed fire combined with wildfire managed for resource objectives) on the Inyo National Forest than in alternatives B and D. However, alternative C would have higher levels of fire restoration than alternative A. There would be low to moderate levels of wildfires used primarily to meet resource objectives and these would occur mostly at higher elevations. Overall, there would be a slight increase in fire regime integrity compared to alternative A. The higher levels of prescribed fire and emphasis on cooperation with

Tribes and restoration of areas of tribal interest would result in increased beneficial fire effects to plants and animals in treated areas.

Subalpine and Alpine Zone

The consequences to subalpine and alpine vegetation in alternative C would be the same as described for alternative A.

Eastside Shrublands and Woodlands

In eastside sagebrush and pinyon-juniper there would be slightly increased fire regime integrity and beneficial fire effects from restoration proposed in alternative C compared to alternative A. Fire regime integrity in mountain mahogany and xeric shrub/blackbrush would be similar between alternatives C and A.

Carbon Stocks, Sequestration, and Stability

Impacts of alternative C on carbon would be similar to alternative A, except that there may be more prescribed fire and wildfire managed to meet resource objectives. There is a high level of uncertainty on how much more fire may occur, because with fewer thinning projects, prescribed fires and wildfires managed to meet resource objectives may be more difficult to implement and could be less likely to occur. Therefore, there is a high level of uncertainty on the impacts of alternative C on carbon. If more beneficial prescribed and managed fires occurred, then there would be short-term increases in carbon emissions but a long-term increase in carbon stability. Burned areas would have lower surface fuels, lower vegetation densities, and higher fire resilience, making the likelihood of large, high-intensity fires lower.

Landscape Connectivity

Alternative C would result in similar impacts to connectivity as alternative B but with more recommended wilderness and an increased likelihood of large, high-intensity wildfires. There would be a similar emphasis on restoration of fire resilience of key forest wildlife linkage areas. Restoration in the remaining area would be uncertain. There would be lower amounts of thinning, similar to alternative A, and the thinning would be at a lower intensity. The plan objectives for prescribed fire and fire managed primarily to meet resource objectives is greater than the proposed action, but there is moderate to high uncertainty how much would occur over the plan period, because there would be less associated thinning in strategic areas. This could make it more difficult to implement prescribed burning because burns would be more risky to manage with higher fuel levels and would be more costly to implement.

There are more recommended wilderness areas in alternative C than the other alternatives. This may provide for increased landscape connectivity of species that are impacted by more intensive management (like mechanical treatment) or uses (such as developed recreation). See the “At-risk Terrestrial Wildlife Species” section for more information.

Important Seral Stages

Old Forest

Management under alternative C in old forests would be similar to alternative A. There would be diameter limits restricting large tree harvest in all areas. Overall, there would be the least amount of area proposed for restoration treatment in old forest under alternatives C and A. There would be an increased emphasis on prescribed fire and the use of wildfires managed to meet resource objectives, but it is uncertain how much of this would occur because dense forest conditions would continue that make burning difficult.

Alternative C would retain all large-diameter trees, with limited exceptions. There would be retention of old forest with denser trees and canopy cover. There would be an increased likelihood that large, old trees would die from drought, insects, pathogens, and warming climate (Van Mantgem et al. 2009). There would continue to be an increasing and high likelihood of large, high-intensity fires, similar to alternative A. This would have a negative impact on old forests in some areas, although there is uncertainty about the resulting fire severities and how they overlap with old forests. Although there would be an increased emphasis on restoration of fire, it is unlikely that this would occur across large areas because it is more difficult to accomplish in dense forest conditions.

Overall, there would be little to no change in large tree density from the restoration treatments, because there would be restrictions on harvest of large trees. There could be a positive impact on old forest structure, increased heterogeneity, and increased resilience from restoration treatments, including thinning, prescribed burning, and wildfires managed to meet resource objectives. There may be some low levels of large tree mortality from fire treatments. The area that is proposed for restoration is lower than other alternatives and because of this there would continue to be an increased likelihood of large high-intensity wildfires. It is uncertain when and where large, high-intensity fires might occur, but if they did there could be negative impacts if they burn large areas of old forest at high intensity and result in killing a lot of large trees.

Complex Early Seral Forest

In alternative C there would be marginally more complex early seral forest than under all other alternatives. There would be very limited salvage, only associated with safety hazards and limited strategic fuel treatment areas. There would be little to no reforestation or herbicide use; instead natural regeneration would be emphasized to minimize disruption of natural processes. There would be the greatest increased likelihood of large, high-intensity wildfires, and overall burned area (see Fire-Climate supplemental report; Westerling, Milostan, and Keyser. 2015). The spatial pattern of complex early seral forest is difficult to predict but there is a higher likelihood of large (100 to 1,000 acres), and very large (greater than 1,000 acre) patches of mixed- and especially high-severity (greater than 75 percent basal area mortality) fires. There would also be an increased likelihood of very large (greater than 10,000 acre), very high-severity (greater than 90 percent basal area mortality) fire patches, based upon increases in fire-atmospheric interactions (from fire created weather, see the “Fire Trends” section).

Early seral forest is currently within or slightly exceeding the natural range of variation for montane forest vegetation types on the Inyo National Forest (see Vegetation Condition Assessment Supplemental Report). Although projected future increases in uncharacteristic wildfire will increase proportions of complex early seral forest in the Sierra Nevada montane zone, increased fire restoration treatments rates in this zone for alternative C would partially mitigate this trend of increasing wildfire severity. This would bring the proportion of complex early seral forest closer to the natural range of variation despite future increases in wildfire severity and frequency. However, increased levels of fire restoration without mechanical pre-treatment in alternative C would lead to additional production of complex early seral habitat. This would supplement the proportion of complex early seral forest to a level clearly exceeding the natural range of variation in some montane forest landscapes of the Inyo National Forest.

Keystone Species Groups

Pollinators – There would be similar impacts to pollinators in alternative C as in alternative A. There would be some increased emphasis on restoration of vegetation heterogeneity and fire restoration that could create sunny openings and improve pollinator habitat. However, canopy cover retention in montane forests would limit these areas. In shrublands, there would be similar impacts to pollinators in alternative C as in alternative B, with some benefits to pollinators resulting from increased annual cover in restoration areas, and some benefits to diversity maintained by the structural diversity of tree cover.

Cavity Excavators – There would be an increase in the amount of habitat for primary cavity excavators because there would be an emphasis on snag retention. This would occur mostly in denser canopied forests and complex early seral forest because there is less restoration proposed. Denser stands would have greater live tree mortality, creating more snags. There may be more habitat in areas burned at mixed severity since there would be more prescribed fire and fire managed to meet resource objectives. However, there is uncertainty how much fire restoration would occur because there would be fewer areas treated mechanically and with prescribed fire that could assist with better management of those fires.

Tribal Uses and Biocultural Diversity

Similar to alternatives B and D, there would be an increased consideration of tribal interests in ecological restoration and coordination of some of the projects. Overall, there would be less ecological restoration across the landscape, providing fewer benefits to ecosystems, plants, insects, and animals of tribal interest.

Integrated Terrestrial Ecosystem Sustainability

There would be limited increases in integrated terrestrial ecosystem sustainability in alternative C, similar to alternative A. This is because there would be limited areas of restoration.

Consequences Specific to Alternative D

Fire Regimes and Fire as an Ecosystem Process

Consequences for alternative D would be similar to alternative B in type but would differ in pace and scale. Therefore, the analysis is focused at larger landscape-scale differences and not by specific vegetation types.

There would be a generally higher amount of restoration treatments in alternative D that would have a substantial impact on fire regimes and fire as an ecosystem process in the landscapes where these treatments occur. This would occur most in large areas in the eastside Jeffrey pine and sagebrush, the latter of which has been invaded by pinyon-juniper and Jeffrey pine. A greater amount of these treated landscape areas would have reduced fire intensity and severity. There would be increased beneficial effects of restoring fire as an ecological process because there would be more opportunities to manage wildfires to meet resource objectives. Alternatives D and C would have the greatest levels of restoration that specifically target sagebrush habitat for the greater sage-grouse.

The consequences for subalpine and desert vegetation types would be similar to alternative B. There would be some additional restoration in red fir and lodgepole pine forests that would reduce fire intensity and severity.

Carbon Stocks, Sequestration, and Stability

The impacts of alternative D on carbon would be similar to alternative B but with beneficial impacts over a larger area. Under alternative D, the area proposed for thinning is the greatest. There would also be the greatest amount of wildfire managed to meet resource objectives. The combined effect of these restoration treatments would be between 30 and 60 percent of the low and mid-elevation areas with lower forest and vegetation densities and fuel loadings. This would substantially decrease the likelihood of large, high-intensity fires. This means that carbon stability would be substantially higher and large carbon emissions the lowest (see the "Air Quality" section).

Landscape Connectivity

Alternative D would result in similar impacts to landscape connectivity as alternative B but with less likelihood of large, high-intensity wildfires that could potentially interrupt habitat connectivity for forest-associated species. This is due to the increased restoration treatment rates under alternative D compared to other alternatives. There would be more fire managed to meet resource objectives under alternative D, which could enhance overall long-term ecosystem resilience of forest linkage areas and other habitat connections. However, there would be higher levels of mechanical thinning in alternative D than alternative B, including within forest linkage areas. Consequently, alternative D would likely result in greater long-term connectivity but significantly lower near-future (next 10 to 20 years) habitat connectivity for forest-associated species than other alternatives.

Important Seral Stages

Old Forest

Alternative D would have similar environmental consequences to alternative B, but with more area restored there would be greater positive impacts of increased heterogeneity, decreased forest density, and increased old forest resilience. Instead of restrictions on harvesting large trees of a certain diameter, alternative D emphasizes managing toward the desired conditions for large trees. This is the only alternative that could result in a reversal of the trend in large, high-intensity fires.

Increased mechanical restoration treatments would result in lower levels of large and old tree mortality from both water stress and large, high-intensity fires. The higher levels of mechanical restoration would increase the likelihood that more prescribed fire and wildfire managed to meet resource objectives would occur and these would have a positive impact on old forests. The impact to large trees in alternative D across the entire analysis area (outside of wilderness or other areas with no or highly restricted mechanical treatment) would be the same as described for alternative B within the fire protection zones.

The direction in alternative D for large trees focuses on desired conditions for large tree densities and guidelines to meet those desired conditions in vegetation management activities (such as restoration thinning or timber harvest) instead of the current diameter limits in alternative A. This may result in some removal of individual large trees, but it is expected to be very limited because large tree densities are lower than desired conditions in most landscape areas. The exception to this situation would be the same as that described under alternative C primarily to thin dense, uniform, young but large white fir to make them more resilient. The harvests of some large trees, even though limited, may result in a small reduction in large tree densities, greater than in alternatives A, B, or C. These reductions may be offset and lower than losses of large trees in alternatives A, B or C from mortality due to water stress and large, high-intensity fires. It is unknown how much of an offset would occur.

The proposed levels of restoration in alternative D would result in numerous large landscape (greater than 10,000 acres) areas exceeding 40 percent and up to 60 percent or more of the area restored. The fire-climate scenarios show a substantially decreased likelihood of large, high-intensity fires with this level of restoration (see the "Fire Trends" section). Therefore, the likelihood of large, high-intensity fire that could result in killing a lot of large trees and converting large areas to early seral vegetation would be decreased compared to current trends. This is the only alternative to result in a reversal of the trend in large, high-intensity fires. This would not likely be achieved until the middle and later parts of the planning analysis period (10 to 15 years) because of the time it takes to plan and implement projects. There may be large, high-intensity fires that occur in the early part of the analysis period. If large stewardship projects occur across very large landscapes (greater than 100,000 acres), then it is possible that the projects may occur more rapidly because there would be fewer limitations on the internal capacity to plan and implement the projects.

Complex Early Seral Forest

There would be some limited impacts of alternative D on complex early seral forest. There would be more restoration treatments that would increase the likelihood that fires that would occur would have low or mixed fire-severity effects. This would include more prescribed fires and wildfires managed to meet resource objectives, which would increase the amount of distributed, fine and medium grained, or patches of complex early seral forest. There would be a reduction in the likelihood of large, high-intensity fires that would also reduce the potential for very large patches of complex early seral forest. There would be a marginally greater amount of reforestation. Compared to alternative B, this alternative would marginally decrease the proportion of large, high-intensity fires that have high levels of complex early seral forest. In addition, early seral forest would currently be within or slightly exceeding the natural range of variation for montane forest vegetation types on the Inyo National Forest (see Vegetation Condition Assessment Supplemental Report). Although projected future increases in uncharacteristic wildfire and fire severity would increase proportions of complex early seral forest in the Sierra Nevada montane zone, increased restoration treatment rates in this zone for alternative D would likely mitigate this trend of increasing wildfire severity. This would bring the proportion of complex early seral forest closer to the natural range of variation despite future increases in wildfire severity and frequency.

Keystone Species Groups

Pollinators – Alternative D would have similar environmental consequences as alternative B but across more area.

Primary Cavity Excavators – Alternative D would have similar environmental consequences as alternative B for cavity excavators.

Tribal Uses and Biocultural Diversity

Alternative D would have similar environmental consequences as alternative B for tribal uses and biocultural diversity, but across more area.

Integrated Terrestrial Ecosystem Sustainability

Alternative D would have similar environmental consequences as alternative B for integrated terrestrial ecosystem sustainability but for considerably more area. The amount of landscape area that would be restored would provide for a higher level of overall integrated sustainability since many of the benefits increase with larger areas treated. For example, the “Fire Trends” section notes how the difference between restoring 60 percent of a landscape area results in a reduction in the increase in large fire size and area.

Cumulative Effects

Fire Regimes and Fire as an Ecosystem Process

Overall, climate change may accentuate the differences among alternatives. This is because fire frequency and intensity are projected to increase in many landscapes with rising temperatures, increasing fuel loading, and decreasing fuel moistures. In general, the cumulative effects described in the "Fire Trends" and "Climate Change" sections apply to fire ecology as well.

Carbon Stocks, Sequestration, and Stability

Cumulative effects for carbon are a complex topic, because of the interactions involved between vegetation in the forest and carbon dioxide in the atmosphere that comes from many diverse sources outside of the national forest. Here the cumulative effects emphasize those aspects of carbon that are vegetation related, namely carbon stability, storage, and sequestration. There is some reference to carbon release from vegetation but more detail can be found in the "Air Quality" section.

Restoration treatments and wildfires on adjacent lands that can burn onto the national forest are the two primary influences on the cumulative effects on carbon and vegetation. Restoration treatments on adjacent national parks (Yosemite and Sequoia and Kings Canyon), and Bureau of Land Management-managed lands can result in areas of increased fire resilience and carbon stability. These areas of increased fire resilience would make it less likely for large, high-intensity fires to move from these lands onto national forest lands.

Landscape Connectivity

The cumulative effects of the alternatives combined with climate change, uncharacteristic fire, insects, and other stressors on landscape connectivity are complex and difficult to disentangle. However, it is anticipated that these stressors, irrespective of the alternatives, will likely have synergistic interactions that amplify their impact on habitat connectivity in the southern Sierra Nevada. Based on fire and climate model projections, it is anticipated that these synergistic interactions would have the greatest negative impact on habitat connectivity under alternative A, which promotes the fewest measures that protect or build adaptive capacity in habitat corridors or linkage areas. Alternatives B, B-modified, C, and D would result in similar levels of cumulative impacts to connectivity, with greater reliance on minimizing short-term impacts in alternative C followed by alternatives B and B-modified (similar).

Important Seral Stages

Old Forest

The cumulative effects of the alternatives on old forest are influenced by management on adjacent lands, factors that influence fire and status, and conservation plans for old forest-associated species (such as California spotted owl, fisher, and marten).

The combined effects of increased restoration of old forests and restoration on adjacent national forest and park lands combine to move more total area in old forest toward desired conditions and the natural range of variation. There are extensive areas of old forest in the two national forests and two national parks that share borders and are intermixed with the Inyo National Forest. Sierra National Forest and Yosemite National Park are to the northwest of the Inyo National Forest. Sequoia National Forest, the Giant Sequoia National Monument, and Sequoia-Kings Canyon National Parks lie to the east of the Inyo National Forest. The very old giant sequoia forests in the national park and adjacent national forests were analyzed in the Giant Sequoia National Monument Plan Environmental Impact Statement and Sequoia and Kings Canyon National Parks

Natural Resource Condition Assessment (Sydoriak et al. 2013a) and that information is not repeated here. Old forests of the Sierra and Sequoia National Forests will be addressed in the Sequoia and Sierra Forest Planning Environmental Impact Statement.

At higher elevations, there are extensive areas of mature and old forests in Sequoia-Kings Canyon and Yosemite National Parks and Sierra and Sequoia National Forests. The National Park Service and Forest Service have coordinated multiple times on wildfires managed to meet resource objectives in these areas and would continue to do so under all alternatives. Fires cross boundaries often. The cumulative effect is that there are large areas in Sequoia-Kings Canyon National Parks that have been restored adjacent to the large areas that have been restored in the Kern River drainage. This restoration has improved the resilience of old forests to large, high-intensity fires and increased heterogeneity and restored species composition. All of the alternatives would continue this cooperative, beneficial management of fire across the boundaries.

Complex Early Seral Forest

Management of large fires and post-fire restoration in adjacent national parks, monuments and national forests to the west are the primary contributors to cumulative effects on complex early seral forest. Yosemite and Sequoia and Kings Canyon National Parks do little post-fire restoration that is likely to reduce the amount of complex early seral forest. There is no post-fire salvage in national parks, except along major roads. Future projected trends in large, high-intensity fires from climate warming in national parks are similar to likely trends in national forests (Westerling, Milostan, and Keyser. 2015). With increased likelihood of large, high-intensity fires and limited post-fire restoration, the cumulative effect would be to have an overall increased amount of complex early seral forest across the analysis area. The Sequoia and Sierra National Forests and southern portion of the Stanislaus National Forest to the north have had repeated, large, high-intensity fires, most recently including the very large Rim Fire. This resulted in several very large patches of complex early seral forest habitat and many moderate and small patches. There has been extensive roadside hazard salvage and planned salvage across large areas, but because of the very large burn perimeter, there still was a large cumulative increase in complex early seral forest habitat. Overall, with increased fire trends throughout and varying levels of salvage, the cumulative effect of all alternatives would have an increase in the amount of complex early seral forest.

Keystone Species Groups

The cumulative effects of the alternatives and various stressors on keystone species groups are varied. In the near future (next 10 to 15 years), the synergistic effects of climate change, uncharacteristic fire, air pollution, invasive species, and insect and pathogen activity would likely benefit cavity excavators and pollinators under all alternatives, because these stressors would increase the amount and proportion of early successional habitat and tree mortality that benefits cavity excavators and pollinators (by providing increased foraging habitat). However, greater loss of “green forest” may have unknown impacts to other cavity excavators and pollinators that also depend on this habitat for nesting or foraging during some stage in their life cycle (like pileated woodpeckers, hairy woodpeckers, or Williamson’s sapsuckers). In the long-term (decades) the loss of forests due to increasing stressors (especially climate change) would reduce the habitat extent for these keystone species regardless of episodic increases in early seral habitats following fire and other ecological processes.

Tribal Uses and Biocultural Diversity

Cumulative effects for tribal uses are a combination of what is described in the sections discussing tribal interests, vegetation ecology, fire ecology, economic and social conditions, and fire and climate trends. Overall, the trends in ecosystem conditions that support tribal uses would be improved from the restoration treatments and greater tribal cooperation and involvement. But the economic and social conditions for Tribes outside of the national forest where they live can influence their ability to access and use the ecosystems. Better economic and social opportunities would provide a greater ability to use these ecosystems.

Integrated Terrestrial Ecosystem Sustainability

The varied aspects of integrated terrestrial ecosystem sustainability are complex when considered individually, as well as when considered together. However, the cumulative effects for each are similar. The effects of climate are the dominant overarching outside influence that affects all aspects, especially fire and nonnative invasive plants.

Analytical Conclusions

Fire Regimes and Fire as an Ecological Process

Sierra Nevada Montane and Subalpine and Alpine Zones

The alternatives vary in restoration of fire regime integrity and fire as an ecological process by ecological zone and location. Alternatives B, B-modified, C, and D would increase fire regime integrity and fire as an ecological process in the Sierra Nevada montane zone, subalpine and alpine zone, and Kern River drainage because of an increased potential to have wildfire managed to meet resource objectives. Large, high-intensity fires are likely to have moderate behavior in these restored landscapes and would result in reduced fire severity and effects. Alternative D would have the greatest positive benefit to fire regime integrity across the Inyo National Forest because at least half of the entire forest area would be restored. Alternative B would only have less of this area restored compared to alternative D. Alternatives A and C would have the lowest levels of restoration, primarily due to fewer opportunities to manage wildfires for resource objectives under these alternatives.

The alternatives differ in proposed restoration of fire as an ecosystem process, especially in the montane zone. Alternatives B and B-modified have prescribed fire objectives that would substantially increase the prescribed burning levels over alternative A, but there is a moderate uncertainty that this amount of prescribed fire would occur because of air quality concerns. With warming climate, drought, and longer and drier fire seasons, spring burning is increasingly important to achieving prescribed fire objectives. There are fewer limited operating periods in alternative D and a higher likelihood that prescribed fire would occur, although there is uncertainty whether air quality conflicts would prevent burning at any time of the year.

Eastside Shrublands and Woodlands

Restoration treatment rates in eastside shrublands and woodlands are greatest under alternatives D, B, and B-modified, and lowest under alternatives C and A. However, all alternatives would support at least moderate fire regime integrity in many eastside shrublands and woodlands (such as xeric shrub/blackbrush), because of the long historic fire return intervals in these vegetation types that often exceed 100 to 200 years (greater than the current fire exclusion period of the 20th and early 21st centuries). These vegetation types are less departed from the desired conditions than other more productive vegetation types in the analysis area. Alternatives B, B-modified, and

D would have the greatest levels of restoration in sagebrush habitat for the greater sage-grouse and the least amount of undesirable fire in landscapes where these treatments exceed 30 percent of the area.

Carbon Stocks, Sequestration, and Stability

Alternative D, followed by alternatives B and B-modified (latter are similar), would have the greatest positive impact on carbon stability, and as a result, on carbon storage and sequestration. They have the greatest proportions of vegetation restoration that would decrease the likelihood of large, high-intensity fires and increase the resilience of vegetation to fires. This would result in less tree mortality maintenance of carbon storage. Carbon sequestration would be more stable and would likely increase because of less competition between trees for water, light, and openings that would improve understory shrub and plant vigor. Alternative D would have the greatest positive impact, because there is enough of the low and mid-elevation areas restored that could reduce the amount of large, high-intensity fires (see the “Fire Trends” section).

Alternatives A and C would likely result in a continued condition of high instability of carbon. There would be a continued increase in the likelihood of large, high-intensity fires and low climate adaptive capacity. There would continue to be large areas of the landscape with low ecological fire resilience and resilience to insects and pathogens (see “Insects and Pathogens” section). This means that there would likely be large areas burned as crown fires in large, high-intensity fires, or areas with widespread tree mortality due to moisture stress and insect and pathogen activity. While dead trees can store much of their carbon in the stems and branches, this is short-term carbon storage, because decay and other ecological processes (like fire) release carbon to the atmosphere (North and Hurteau 2011). Carbon sequestration could increase because of more young vegetation actively growing after large fires. This increase in sequestration would likely be short term in both alternatives. In alternative C, there would be little to no reforestation and therefore, lower levels of sequestration in post-fire landscapes characterized by large high-severity fire patches with increased tree regeneration failure (Ritchie and Knapp 2014, Collins and Roller 2013). In alternative A, while there might be marginally more reforestation, if it is extensive and densely planted, there is a moderate to high likelihood that the plantations (which are uncommon on the Inyo National Forest) would not survive additional large, high-intensity fires and climate change. There is often, but not always, a pattern of repeated fires in the same vicinity, that burn intensely through plantations. The most notable examples are on the Stanislaus National Forest, near and in the Rim Fire area, which were often established following earlier uncharacteristically severe wildfire events (like the 1987 Stanislaus Complex).

Landscape Connectivity

Alternatives B and B-modified potentially provide for short- and long-term habitat connectivity, especially for forest-associated species such as marten. Alternative C provides the greatest short-term connectivity but at the cost of elevated exposure or sensitivity to uncharacteristically severe fire, climate change, and other stressors that reduce long-term habitat connectivity. Alternative D may support the greatest long-term habitat connectivity, but at the cost of significantly reduced short-term habitat connectivity resulting from elevated mechanical and prescribed fire treatment rates in the next 10 to 20 years. Alternative A provides the lowest connectivity for forest-associated and other wildlife species under both short- and long-term horizons. Alternative A provides the lowest restoration treatment rates and lacks management approaches that are specifically focused on habitat linkage and dispersal corridor areas otherwise promoted under alternatives B, B-modified, C, and D for wildlife species such as marten. Consequently, alternative D would result in the greatest habitat connectivity for forest-associated and other species.

Important Seral Stages

Old Forest

Alternative D, followed by alternatives B and B-modified (latter are similar), would result in the greatest restoration of old forests. There would be more old forests that have restoration of desired tree density, heterogeneity, tree canopy cover, fire regime integrity, and fire as an ecosystem process in these alternatives. This would restore old forests toward conditions reflecting the natural range of variation. There would be substantially increased resilience of large, old trees to moisture stress, drought, insects and pathogens, ozone, and large, high-intensity fires. There is potential for harvest of some large trees in alternative D and within the fire protection zones in alternatives B and B-modified, because the direction to limit the size of trees removed is provided by desired conditions for old forests compared to fixed harvest diameter limits. It is unknown how much harvest of large trees would occur, but it is assumed that it would be low because many areas are below desired conditions levels for large trees.

The greatest impact to old forests, aside from direct harvest of large trees, is trees dying from large, high-intensity fires and the combined effects of drought, insects and pathogens. Large, high-intensity fires can kill many large trees, across large areas at one time. The fire-climate research by UC Merced (Westerling, Milostan, and Keyser 2015) supports that there has been and will continue to be an increase in the size, number and area burned in large fires due in part to warming climate. In restoration scenarios, the trend did not change or reverse until 60 percent of the montane landscape was restored. Restoration levels of 15 and 30 percent showed less increase of large fires compared to no treatment but there would still be increases in large, high-intensity fires compared to today.

In all alternatives, the Kern River drainage would reach the 60 percent restoration level rapidly, because it is already near or exceeding 30 percent in many areas. For all other areas, alternative D is the only alternative that comes close to the 60 percent restoration level. This alternative is most likely to have the least loss of old forest from large, high-intensity fire. Alternative B would have a similar impact in some areas but not all. In all alternatives, there is uncertainty as to what proportion of large fires would be dominated by high severity, mixed severity or low severity effects, even though relative qualitative comparisons could be made among alternatives. Larger proportions of high-severity fire is likely under alternatives A and C and higher proportions of low and moderate severity fire are more likely under alternatives B, B-modified, and D. Even with the very large Rim and King Fires, there were significant portions of the fires that burned at moderate, mixed or low severity, especially within higher elevation forests (such as red fir and lodgepole pine). Similar patterns occurred with the Aspen and French Fires on the Sierra National Forest. These areas of low and moderate fire severity may result in some large trees dying, but overall would provide benefits of increased heterogeneity, desirable habitat features (such as snags), and resilience on some parts of fires but would have very severe effects for old forest in other parts of the fires that burn at high severity.

Old forests can also be greatly impacted by drought, insects, and pathogen-related mortality. Where forest density is high, all trees are vulnerable to mortality, including the large trees. Current levels of mortality in some mixed conifer and Jeffrey pine forests are elevated. Mortality of younger and medium-sized trees from surrounding younger forests increases the likelihood that large trees will die because the elevated insect levels increase the extent and rate of infection.

Alternative D, followed by alternatives B and B-modified (latter alternatives are similar), would have the greatest reduction in vulnerability to future drought, insect, and pathogen-related large tree mortality because the greatest intensity of forest thinning across large areas would occur and greater levels of fire restoration. The net result is that only a small portion of remnant large old trees would benefit from restoration treatments of intensity needed to increase resilience. This may be less than 10 percent of the areas with large, old trees. Alternatives A and C would have even lower levels of benefit from restoration because treatments would be less intense and less extensive, especially with regards to fire restoration.

Complex Early Seral Forest

The increase in complex early seral forest would be highest in alternative C, followed by alternatives B, B-modified (similar), and D, and the least in alternative A. There is a high level of uncertainty about the amount and spatial scale of the complex early seral forest patches that would occur because of the high uncertainties associated with fire. However, there is a high likelihood of increased fires under all four climate scenarios used to project large fires (Westerling, Milostan, and Keyser. 2015). Additionally, the difference in complex early seral habitat among alternatives is rather slight, owing to the very low rates of reforestation and virtually non-existent levels of post-fire salvage on the Inyo National Forest.

Current proportions of complex early seral forest in the Sierra Nevada montane zone of the Inyo National Forest are either within or slightly exceeding the natural range of variation. The proportion of complex early seral forest will likely remain within the natural range of variation in most alternatives because: (1) the application of forest restoration treatments will reduce levels of uncharacteristic wildfire that will likely produce an excessive level of early seral forest, and (2) a near absence of post-fire management activities on the Inyo National Forest will have negligible impacts on complex early seral forest habitat. However, alternatives A and C would likely result in some landscapes with an excessive level of complex early seral forest (exceeds the natural range of variation) due to reduced restoration treatment rates and increased levels of uncharacteristic wildfire.

Keystone Species Groups

Pollinators – Alternatives B, B-modified, and D would provide the greatest restoration of habitat to support improved pollinator habitat in forested ecosystems. There would be the greatest amount of restoration, when considering the combination of prescribed fire, mechanical thinning, and wildfire managed to meet resource objectives, at an intensity and spatial pattern to create openings, more open canopy, and sunlight on the forest floor. Alternative C proposes increased prescribed fire compared to alternative A, but overall restoration treatment rates that promote pollinator habitat are greater in alternative B, B-modified, and D. Alternative A would provide the least restoration of habitat conditions supporting pollinators. In arid woodlands and shrublands, alternatives B, B-modified, and D would provide greater benefit to pollinators dependent on annual plants, in areas where invasive species are not dominant. All alternatives would have very similar impacts for pollinators dependent on perennial flowers.

Primary Cavity Excavators – Alternative C would provide the most snag habitat because of the lower levels of mechanical restoration, increased potential levels of prescribed fire, and higher snag retention levels. Alternatives B and B-modified would provide slightly higher levels than alternatives A and D. Alternative D would provide the lowest levels of snags. It is uncertain for all alternatives what the distribution of snags would be on the landscape among different habitat types (for example young versus old, burned versus unburned forests). As described above in the complex early seral forest discussion, alternatives C followed by alternatives B and B-modified would have the most snag habitat in burned forests but only by marginally greater amounts.

Tribal Uses and Biocultural Diversity

Alternative D, followed by alternatives B and B-modified would provide the greatest increase in ecosystem condition for tribal uses. More restoration would occur in these alternatives that would improve plant, animal, and insect habitat. Alternatives B, B-modified, C, and D, all provide for increased tribal coordination and restoration of areas of tribal interest. These would all increase the amount and quality of restoration benefitting Tribes.

Integrated Terrestrial Ecosystem Sustainability

Table 41 provides an overall summary of conditions for characteristics of integrated sustainability by alternative.

Table 41. Summary of conditions for characteristics of integrated sustainability by alternative

Characteristic	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Terrestrial Ecosystem Condition	Low	Low to moderate (restored areas)	Slightly higher than B	Low	Moderate
Area outside of the natural range of variation (low and mid-elevations)	Very high	Moderate (restored areas) to high	Moderate (restored areas) to high	High	Moderate
Area and percent of forest affected by processes or agents beyond the range of historic variation (by insects, disease)	High vulnerability	Moderate to high vulnerability	Moderate to high vulnerability	High vulnerability	Moderate vulnerability
Area and percent of forest land subjected to levels of specific air pollutants (sulfates, nitrate, ozone) or ultraviolet that may cause negative impacts on the forest ecosystem	Moderate, Jeffrey pine and dry mixed conifer vulnerable	Moderate, Jeffrey pine and dry mixed conifer less vulnerable than A	Moderate, Jeffrey pine and dry mixed conifer less vulnerable than A	Moderate, Jeffrey pine and dry mixed conifer vulnerable	Moderate, Jeffrey pine and dry mixed conifer less vulnerable than A, B, or C
Old Forest Condition and Vulnerability to Stressors	Very low, high vulnerability	Moderate, moderate to high vulnerability	Moderate, moderate to high vulnerability	Low, high vulnerability (higher vulnerability than B and B-modified)	Low to moderate, moderate vulnerability
Complex Early Seral Habitat Amount and Extent	Moderate to high, more large patches	High, more small patches	High, more small patches	Marginally higher than B	Similar to B but less extensive
Limited Plant Community Condition	Mixed, low to high	Moderate to high	Moderate to high	Moderate to high	Moderate to high

Out of all of the alternatives, alternative A provides the least likelihood of sustainability. Alternative D, followed by alternatives B and B-modified, is the most likely to improve the likelihood of sustainability. Alternative C could improve sustainability but there is greater uncertainty because there is more reliance on fire restoration treatments with less ability to treat the areas prior to burning.

Sustainability of old forest condition and extent is most influenced by the amount of restoration of the entire landscape it occurs within as well as the old forests themselves. Alternative D, followed by alternatives B and B-modified, would have the greatest overall levels of restoration and would increase resilience to large fires. Alternative D would have the greatest amount of restoration in old forests outside of the forest protection zones. This would increase the resilience of old forests to drought, insects, pathogens, air pollution and high-intensity fire. However, some large trees might be harvested. Alternatives A and C would have the most restrictions on restoration of old forest and vegetation overall. This might provide short-term protection for old forests but also increase the susceptibility of mortality from drought, air pollution, insects and pathogens and high-intensity fire. Alternatives B and B-modified provide the greatest balance of short- and long-term protection and integrity of old forests by maintaining higher restoration rates (higher than alternatives A and C) that reduce impacts of stressors, while providing for greater retention of large and old trees than alternative D, particularly outside the wildfire protection zones. Accordingly, alternatives B and B-modified would contribute most to the ecological sustainability of old forest condition.

Climate, Ecological Vulnerability and Adaptation

Background

This section summarizes ecological vulnerabilities to climate changes and effects of adaptation strategies and plan direction addressing ecological impacts of climate change. This section examines the overarching and critical effects of climate change on terrestrial and aquatic ecosystems. It adds detail to the general discussions in the “Terrestrial Vegetation Ecology” section on individual vegetation types.

Analysis and Methods

This section summarizes the detailed analysis of climate vulnerability and adaptation found in the bio-regional and forest assessments (USDA Forest Service 2013a, 2013b, 2013c, and 2013d), the snapshots of the “Living Assessment” used to develop the final assessments (USDA Forest Service 2013e, 2013f, 2013g, and 2013h), and the Pacific Southwest Science Synthesis (Long et al. 2014). Additional information from several recent climate change vulnerability and adaptation assessments Kershner 2014, Finch 2012, Schwartz et al. 2013a, Lenihan et al. 2003 and 2008, and Thorne et al. 2017) and natural range of variation assessments (Safford et al. 2013a) are also incorporated.

Indicators and Measures

Ecological vulnerability indicators include tree mortality, distribution of species (elevational distribution of plants and animals), presence of nonnative invasive species, and changes in fire regime (changes to frequency, size, and severity).

Adaptation strategies can increase the resilience of ecosystems and resources to climate change impacts (Intergovernmental Panel on Climate Change 2014). Short-term adaptations build resistance and resilience, so that ecosystems are better able to withstand undesirable effects of climate changes such as diminished ecosystem integrity and function. In table 44, the alternatives are compared by their relative capacity to support various climate adaptation approaches that are recommended by climate vulnerability assessments and other best available science information sources. These approaches include: (1) increase adaptive capacity of ecosystems through ecological restoration and climate adaptation, (2) develop and use collaborative partnerships, (3) apply climate vulnerability assessments in planning and prioritization, and (4) use monitoring and adaptation. Collaborative partnerships are addressed in the “Benefits to People” section.

The primary adaptation strategies are listed below. These are based upon several recent climate adaptation workshops (Southern Sierra Partnership 2010, Nydick and Sydoriak 2011c, Kershner 2014) as well as scientific literature on climate change (North, Stine, O'Hara et al. 2009; Finch 2012; Lawler, Safford, and Girvetz 2012; Safford et al. 2012; Safford, North, and Meyer 2012; Millar, Stephenson, and Stephens 2007; Hanberry et al. 2015).

- Manage for vegetation heterogeneity and diversity;
- Restore or maintain key ecological processes, including fire in fire-adapted forest ecosystems;
- Reduce the density of smaller diameter, shade-tolerant trees in fire-adapted forests to levels more consistent with the natural range of variation;
- Reduce the chance of uncharacteristically large and severe wildfire and other climate-related stressors using ecologically appropriate treatments, including prescribed fire, mechanical thinning, and wildfires managed for resource objectives within the natural range of variation;
- Implement rapid detection of and response to invasive species;
- Restore ecosystem function to degraded meadows, aquatic and riparian ecosystems;
- Identify and protect future climate refugia for other areas of native species persistence;
- Maintain and restore habitat connectivity across the ecoregion to facilitate species movements under rapidly changing conditions; and
- Enhance recruitment and expansion in species that are ecologically underrepresented (aspen), functionally important (whitebark pine), or climate resilient (pines). This includes consideration of plant species and genotypes that may be adapted to warmer or drier climate conditions in reforestation efforts.

Assumptions

- Ecological response models assess the response of ecosystems (vegetation, wildlife habitat) to climate change. These models include additional assumptions that increase the level of uncertainty (Glick, Stein, and Edelson 2011).
- The outcomes of management actions with climate change are also highly uncertain. However, best strategies for adapting to future change will be based on adaptive land management strategies that consider historic, current, and future projected changes in climate and climate-related processes (Wiens et al. 2012). This provides a more comprehensive evaluation of the effects of climate change in the absence of robust projections of future climate and climate-related processes (Safford, North, and Meyer 2012).

- Plan components that specifically address climate change, including desired conditions and management approaches, will result in improved climate adaptation.
- Climate change is a primary stressor that has wide-ranging impacts and a strong interaction with other ecological stressors in the plan area, including wildfire, drought, insects, pathogens, air pollution, and invasive species.
- Plan components that result in increased pace and scale of restoring vegetation to a more resilient condition (desired conditions that reflect the natural range of variation) will substantially improve the capacity for climate response of major vegetation types. Thus, the increased pace and scale of restoration treatments will provide greater support of climate adaptation strategies focused on enhancing ecosystem resilience.
- Increased pace and scale of restoring vegetation will include proportionate measures to prevent or control nonnative invasive plant species to the extent possible.

It is assumed that the different adaptation strategies are equally important. However, depending upon the vegetation type, species or ecosystem process, that some strategies may be more important than others in a particular situation. Differences in the importance of adaptation strategies by vegetation type, species or ecosystem processes are analyzed in the "terrestrial Ecosystems," "Aquatic and Riparian Ecosystems," and "Species of Conservation Concern" sections.

Affected Environment

Studies of terrestrial mammals, birds, and butterflies show that ranges of many species have been shifting to higher elevations and shrinking in high elevation zones, probably in response to warming temperatures and changing precipitation patterns (Safford et al. 2012). Similar sensitivities are suggested for aquatic and riparian species (Hauptfeld and Kershner 2014a).

As described in the "Agents of Change," "Terrestrial Vegetation Ecology," and "Terrestrial Ecosystem Processes and Function" sections, there have been changes in wildfires, tree mortality, and insect populations related in part to climate changes that affect species habitat and distribution. Wildfire frequency, size, total area burned, and fire severity have all been increasing in the Sierra Nevada over the last two to three decades. Larger trees are also dying from factors other than fire throughout many parts of the Sierra Nevada (Dolanc et al. 2014, Van Mantgem et al. 2009). This pattern is frequently associated with increasing moisture stress and bark beetle activity related to increasing temperatures across western North America (Logan et al. 2003 (Logan, Regniere, and Powell 2003, Van Mantgem et al. 2009). More recently, especially in the last several years on the western slope of the southern Sierra Nevada, extensive tree mortality has occurred. In some areas, forests have experienced high levels of tree mortality (see "Insects and Pathogens" section). These elevated levels of tree mortality are likely due to the interacting effects of drought, bark beetles, forest densification, and warming temperatures. Higher winter temperatures allow more insect survival and buildup over winter. There may be a combination of increased drought stress as well as increased respiration of trees (absorb water and release water vapor) in warmer weather (Van Mantgem et al. 2009).

Projected Future Trends in Ecological Indicators

Climate vulnerability assessments for the plan area anticipate broad-scale changes in ecosystem conditions, such as fire regimes, vegetation, insect activity, and species distribution patterns. Table 42 shows the climate vulnerability of different major vegetation types based on the degree of climate exposure (exposure to high rates of temperature change), sensitivity to climate change (sensitivity to changes in moisture availability), and capacity to adapt to changing conditions (ability to disperse or relocate to more favorable environment), which is ranked on a relative scale from high to low based on relative vulnerability among types (low vulnerability indicates a vegetation type that has lower climate exposure, reduced sensitivity to climate change, and higher capacity to adapt to changing conditions). Information sources for climate vulnerability are covered in the analysis and methods section above. Models suggest the area of conifer-dominated forest in the southern Sierra Nevada will decrease substantially, especially for high-elevation forests (like subalpine areas). In contrast, many hardwoods and shrubs are expected to respond more positively than conifers to warmer nighttime temperatures and shifting disturbance regimes (such as increased fire intensity and bark beetle activity). This will result in the transition of some coniferous forest types to arid shrublands and woodlands on the Inyo National Forest. Many scenarios also show an increase in grassland area at lower and middle elevations, as woody vegetation retracts in the face of increased fire frequency and invasion by nonnative annual grasses. This is expected to occur especially at the lower elevations, where sagebrush and pinyon woodlands may shrink in distribution or move upwards in the coming decades.

Table 42. Climate vulnerability of major vegetation types in the plan area

Vegetation type	Climate vulnerability[1]
Subalpine forest and alpine	High
Red fir forest	High
Wet meadow	High
Riparian	Moderate–High
Dry mixed conifer and Jeffrey pine forest	Moderate–High
Xeric shrubland and blackbrush	Moderate
Sagebrush	Moderate
Pinyon-juniper woodland	Low–Moderate
Mountain mahogany	Low–Moderate
Annual grassland	Low

1. Climate vulnerability indicates the degree to which a vegetation type is vulnerable to the effects of climate change, with the most vulnerable types (i.e., high climate vulnerability) indicative of high climate exposure, high sensitivity to climate change, and low capacity to adapt to future changes. Vulnerability is based on a relative scale of low to high.

Current trends of increasing fire activity (such as longer fire seasons, and changes to fire frequency) and larger burned areas are expected to continue in most vegetation types under almost all future climate scenarios (see “Fire Trends” section). Moisture stress and the frequency and severity of bark beetle outbreaks are projected to increase dramatically with increasing temperatures in the Sierra Nevada, resulting in widespread tree mortality (Bentz et al. 2010, Hicke et al. 2006). This is currently happening on parts of the Inyo National Forest, where tree mortality rates have been substantially increasing and may be approaching the upper limit of the natural range of variation (discussed in the “Insects and Pathogens” section).

Regional climate trend assessments (Safford, North, and Meyer 2012), climate vulnerability assessments (Kershner 2014), and natural range of variation assessments suggest that climate change will have impacts to species that vary by individual plant and animal species. Table 43 shows the climate vulnerability of selected species or species groups in the plan area. This is not an exhaustive list but instead rather representative species that are vulnerable in the different ecosystems in the Inyo National Forest.

Table 43. Climate vulnerability of select species or species groups in the plan area

Species or Species Group	Climate Vulnerability[1]
High-elevation white pines[2]	High
Alpine chipmunk	High
Greater sage-grouse	High
Marten	High
Mountain and Sierra yellow-legged frogs	High
Aspen	Moderate
Clark’s nutcracker	Moderate
Swainson’s thrush	Moderate
Stellar’s Jay	Low

1. See table 42 for a description of climate vulnerability
2. Includes whitebark pine, foxtail pine, bristlecone pine, and limber pine

There will likely be increasing vulnerability of species resulting from direct and indirect effects of climate change. Direct effects will include increasing evaporative demand for plants with warming temperatures and resultant increased water stress. Indirect effects will include habitat loss from vegetation changes. For example, Clark’s nutcracker is dependent on whitebark pine in subalpine and alpine areas for food. If whitebark pine and these forests are heavily impacted by climate change, then Clark’s nutcracker will be heavily impacted.

Many models project significant range contractions in some species distributions, those with high climate sensitivity and low adaptive capacity. For example, alpine plants and animals that live at the highest elevations will have few if any other places to go to stay in the colder environments they are adapted to. Species with low adaptive capacity include those that have small and isolated populations, low genetic variation, and limited ability to move widely and low reproductive rates. Vulnerable species also include those with habitat tied to vulnerable vegetation types. For example, it is predicted that the conditions that support marten presence in California are likely to change greatly over the next century, potentially causing a pronounced loss of suitable habitat (Lawler, Safford, and Girvetz 2012). Marten are closely associated with red fir forests, which are dependent upon snowpack. Lawler, Safford, and Girvetz (2012) suggest that marten will be highly sensitive to climate change, with the largest impacts in the southern Sierra Nevada.

Environmental Consequences to Climate, Ecological Vulnerability and Adaptation

The alternatives were contrasted qualitatively in the opportunity, likelihood and rate of application of adaptation strategies focused on building adaptive capacity of ecosystems from restoration actions (table 44). A rating of high means that there were likely to be numerous opportunities and a high likelihood of applying adaptation strategies in multiple locations. A rating of low meant that there were few opportunities and a low likelihood of applying adaptation strategies on few to no locations. Moderate would be in between, either with a lower likelihood and/or fewer locations where adaptation strategies would be applied.

Table 44. Rating of the amount of application climate adaptation strategies by alternatives (e.g., low indicates a low degree of application)

Climate Adaptation Strategy	Alternative A	Alternative B and Alternative B-modified	Alternative C	Alternative D
Manage for vegetation heterogeneity and diversity	Low	Moderate (in 15 to 25 percent of area)	Low	Moderate to high (in 30 to 60 percent of area)
Restore or maintain key ecological processes (like fire)	Low	Low to moderate (moderate to high in Kern Drainage)	Low	Moderate
Reduce density of small-diameter trees, reduce tree density in sagebrush	Low	Moderate (in 15 to 25 percent of area)	Low	Moderate to high (in 30 to 60 percent of area)
Reduce impacts of climate-related stressors	Low	Moderate	Low	Moderate
Rapid detection and rapid response to invasive species	Low to moderate	Low to moderate	Low to moderate	Low to moderate
Restore and maintain watershed function	Low	Moderate (some low)	Low	Moderate
Restore function of non-meadow riparian vegetation	Low	Low to moderate	Low	Low to Moderate
Restore function of meadow ecosystems	Low	Low to moderate	Moderate	Low to moderate
Improve resilience of aquatic ecosystems	Low	Low to moderate	Low	Low to Moderate
Protect future climate refugia	Low	Low	Low	Low
Post-disturbance climate adaptation response strategies	Low	Moderate	Low	Moderate
Enhance ecologically important species	Low	Moderate	Low to moderate	Moderate
Maintain and restore dynamic habitat connectivity	Low	Moderate to high	Low to Moderate	Low to high
Overall	Low	Moderate (few high, some low)	Low (some moderate)	Moderate (few high, some low)

The climate adaptation strategies were assumed to be equally weighted. There may be different ways to weight them, emphasizing the importance of some (such as reducing vegetation density or protecting future climate refugia) over others. Because this analysis is general and not specific to individual species, it would be difficult to provide ecological justification for a specific weighting scheme, since it would likely vary by individual species. For analysis specific to individual vegetation types or specific species of conservation concern see the “Vegetation Ecology, Wildlife and Plants” sections.

Consequences Common to All Alternatives

Decades of fire exclusion coupled with intensive logging in forest ecosystems of the southern Sierra Nevada have resulted in uncharacteristically high fuel loads and homogenous forest structure (Kilgore and Sando 1975, Mckelvey and Johnston 1992). These conditions increase the susceptibility of fire-adapted forest ecosystems to climate change and related influences on ecosystems including uncharacteristically severe wildfire, insect or disease outbreaks, and drought-triggered mortality (North, Stine, O'Hara, et al. 2009; Stephens, Millar, and Collins 2010). All alternatives include the reduction of small-diameter, shade-tolerant trees to increase forest resilience, although the amount varies considerably by alternative. The desired conditions for vegetation are shared across alternatives B, B-modified, C, and D and they include reduced forest densities and a shift from dominance of smaller to larger trees (DMC-DC-03 to 04; TERR-JEFF-DC-03; TERR-RFIR-DC-03, 05; TERR-LDGP-DC-04, 07, 08).

All alternatives would continue to have opportunities to maintain and restore vegetation in the Kern Drainage using wildfire managed for resource objectives. These areas currently have greater resilience to climate change and related trends in increased fire because extensive areas have had restoration of wildfire managed for resource objectives over the least 15 years (Fites-Kaufman, Noonan, and Ramirez 2005; Vaillant 2009; Meyer et al. 2015). This area has large landscapes that have reduced forest density and fuel conditions. Fires are limited in size when they reach numerous recent fires in the area (Ewell, Reiner, and Williams 2012; Reiner et al. 2016).

Aggressive eradication and containment of established invasive species will be an important component of ecosystem management under a changing climate. This is especially true considering that while fire plays an essential role in vegetation restoration, these same activities can result in invasive plant species introductions and spread (Keeley 2006). Projections are for an increase in burned area with climate change (see “Fire Trends” section). All alternatives include taking an approach to controlling invasive species and preventing their introduction. Similar plan direction from the existing plans has been incorporated into the proposed new plans and would be similar under alternatives B, B-modified, C, and D. This includes desired conditions limiting invasive plant invasion and spread (INV-FW-DC-01 to 02; MA-RCA-DC-01), and management approaches, standards, and guidelines to reduce invasion and spread during management activities using an early detection and rapid response strategy (INV-FW-STD-01; INV-FW-GDL-01 to 06).

No alternatives have identified future climate refugia for native species persistence, except for a desired condition for special habitats that would apply to alternatives B, B modified, C, and D (SPEC-FW-DC-03). However, vulnerability assessments for the southern Sierra Nevada have the potential to identify future climate refugia that can be prioritized for restoration or monitoring. Alternatives B, C, and D would share desired conditions that address connectivity and the ability of species to move and persist across larger areas (MA-RCA-DC-01; RCA-RIV-DC-02; TERR-FW-DC-06; TERR-SAGE-DC-04; TERR-SAGE-GOAL-01b; TERR-OLD-DC-02SPEC-CSO-DC-01; SPEC-SG-DC-04).

No alternatives have addressed prioritization of restoration to address vulnerabilities to climate change. However, alternatives B, B modified, C, and D provide climate adaptation response strategies by emphasizing vegetation restoration to reduce climate-related stressors including large and severe wildfires, insect outbreaks, invasive species, and drought (table 4, page 83).

Monitoring and adaptive management approaches are fundamental to understanding how to respond to the impacts of climate change. All alternatives include monitoring and adaptive management as a component of their plan management strategies, approaches, and tools. Alternatives B, B modified, C, and D apply the 2012 Planning Rule that was developed in part to use a more flexible and adaptive planning process that allows for more frequent and streamlined plan amendments and revisions. This adaptive process, provides greater potential for alternatives B, B modified, C, and D to monitor, learn, and adapt to rapidly changing climate.

Consequences Specific to Alternative A

Alternative A has no management direction specific to climate adaptation or resilience. There is some ecological restoration aimed at reducing forest density but it is limited in intensity and extent. Alternative A has the lowest potential to reduce the risk of undesirable wildfires because of the reduced fuel treatment rates under this alternative that have resulted in a significant fuel treatment “backlog” and fuel buildup in Sierra Nevada forest ecosystems Alternative A would not emphasize forest heterogeneity approaches to promote resilience to the same degree as the other alternatives. Compared to the other alternatives, alternative A has the lowest rate of watershed restoration (less focus on priority watersheds) and has an increased potential for wildfires burning at increased severity outside the historic range of variation that may impair watershed function (such as increased soil erosion and sedimentation). Fewer fuel reduction treatments, less watershed restoration, and less emphasis on heterogeneity restoration would likely result in less prescribed burning and fewer wildfires managed primarily for resource objectives than other alternatives. Although alternative A has the least potential to reduce the risk of large wildfires which would be vulnerable to weed invasion, it also has the fewest restoration activities such as prescribed fire and mechanical treatments that would be vulnerable to being invaded by nonnative plants.

Alternative A provides the least benefit to certain ecologically important species, such as aspen and whitebark pine, because it has the lowest treatment rates in special habitats, unique vegetation types, and whitebark pine stands, and the lowest potential use of wildfire managed primarily to meet resource objectives. Alternative A may incorporate some of these recommendations, but they are not part of the plan direction and there is uncertainty that the recommendations would be implemented. Consequently, alternative A would do the least to integrate climate vulnerability assessments in planning and prioritizing of all the alternatives. Alternative A does not address vulnerabilities to climate change for riparian and aquatic ecosystems. Alternative A does not have plan monitoring components focused specifically on climate change and there are no direct and indirect indicators of changing climate conditions.

Consequences Specific to Alternative B

Alternative B emphasizes plan direction that would increase the resilience of vegetation directly to climate change and indirectly through increased vegetation and watershed resilience to fire, drought, insects, and pathogens. This includes desired conditions on resilience to climate change and sustainability in the face of climate change for watershed and terrestrial ecosystems (WTR-FW-DC-01, -03 to 04; TERR-FW-DC-02, -04, -07, -08) and riparian and aquatic ecosystems (MA-RCA-DC-09; RCA-MEAD-DC-02; RCA-RIV-DC-01; RCA-SPR-DC-02-03). There is a goal to integrate landscape or watershed approaches to restoration that integrates recreation, fuels, partnerships, and vegetation management to effectively address climate change (WTR-FW-GOAL-01).

Alternative B would manage for forest and shrubland vegetation heterogeneity and diversity and restore or maintain key ecological processes (such as fire in frequent fire systems), and key approaches for resilience to climate change through guidelines and desired conditions (TERR-FW-GDL-01; TERR-FW-DC-01; TERR-MONT-DC-01 to 03; TERR-DMC-DC-01 to 03; TERR-JEFF-DC-01 to 03; TERR-RFIR-DC-01 to 03; TERR-LDGP-DC-01 to 03; TERR-ALPN-DC-01, 02; TERR-SAGE-DC-01 to 02; TERR-PINY-DC-01 to 02; TERR-XER-DC-01 to 03). This includes restoration of vegetation density and composition to vegetation types and specific desired conditions that are based primarily on the natural range of variation for those types (see

“Terrestrial Vegetation Ecosystem” section for more detail). In alternative B the assumption is that fire, and low resilience to drought, insects, and pathogens are the greatest risk to all ecosystems. Therefore, the emphasis is on restoring the resilience of terrestrial ecosystems. Alternative B would likely increase structural heterogeneity based on the emphasis of mechanical thinning and prescribed fire treatments to implement concepts of ecological restoration in westside forests (North, Stine, O'Hara, et al. 2009; North 2012b) and vegetation diversity in eastside sagebrush and pinyon-juniper woodlands. This would occur on 15 to 25 percent of the landscape, primarily in the montane, Jeffrey pine, pinyon-juniper and sagebrush vegetation types (TERR-FW-OBJ-01 to 03).

Alternative B would have a moderate likelihood of reducing the chance of uncharacteristically large and severe wildfire and other climate-related stressors in portions of the plan area based on the combined rates of mechanical and prescribed fire treatments and use of wildfire managed to meet resource objectives (see the “Fire Trends” section). Alternative B has greater treatment rates of mechanical treatments, prescribed fire, and wildfires managed for resource objectives (TERR-FW-OBJ-01 to 03) than alternatives A and C. The greater use of mechanical treatment and prescribed fire in the montane, Jeffrey pine, pinyon-juniper, and sagebrush vegetation types would provide greater resilience to climate change, since these vegetation types are most departed from the natural range of variation. The greater use of wildfires managed for resource objectives (MA-WRZ-DC-02 and 03; MA-WMZ-STD-01; MA-WMZ-GOAL-01) would be critical to reduce fuel loading and the vulnerability of forest ecosystems across large spatial scales in the southern Sierra Nevada (Meyer 2015a), especially considering the high level of mechanical constraints in the steep and inaccessible areas that occur in many parts of the analysis area (North et al. 2015). Use of wildfires managed for resource objectives would occur primarily at higher elevations and in the Kern River Drainage where landscape fuel conditions are moderate to low overall. Since red fir, subalpine and alpine ecosystems have a high vulnerability to climate change, continued restoration of fire in these areas would provide increased resilience to climate change.

Alternative B would restore watershed function at a slightly higher rate by increasing the emphasis on priority watersheds for management actions (WTR-FW-OBJ-01) and objectives for water quality improvement projects (RCA-RIV-OBJ-01 to 02). Vegetation treatment rates in riparian ecosystems and meadows would also likely be higher in alternative B (MA-RCA-OBJ-01; RCA-MEAD-OBJ-01) compared to alternative A, resulting in greater resilience to climate change and in some locations resilience to fire under alternative B. There is less emphasis on direct restoration of aquatic ecosystems. There would be limited improvements to aquatic ecosystem resilience as a result. There would continue to be vulnerability of many aquatic ecosystems to changing hydrographs and temperature thus increasing their vulnerabilities to climate change. There would be improvements to resilience of meadows to climate change that are restored as a result of meadow restoration objectives.

In the long term, greater resilience of forest and shrubland vegetation would improve climate resilience in areas where restoration is emphasized and may maintain relatively greater levels of habitat connectivity for forest-dependent species by facilitating species movements into suitable future habitat (higher elevation forests or climate refugia).

Desired conditions are provided to ensure habitat connectivity for wide-ranging species (MA-RCA-DC-01 and 04; RCA-RIV-DC-01; TERR-FW-DC-06; TERR-SAGE-DC-04; TERR-SAGE-GOAL-01b; SPEC-CSO-DC-01; SPEC-SG-DC-04; TERR-OLD-DC-02).

There would continue to be large, high-intensity fires, especially in unrestored areas in the montane and eastside pine, pinyon-juniper and sagebrush landscapes that would disrupt connectivity for some species. Only a portion of the landscape would be restored and fire trends would continue in many areas (see “Fire Trends” section). Species associated with mature forest or shrublands, including marten and greater sage-grouse, would continue to have disruptions in connected habitat in many areas. For more detail, see the “Old Forest” and “At-risk Terrestrial Wildlife Species” sections. There would be consideration of climate change in post-fire restoration. This is from numerous desired conditions that emphasize resilience to climate change (see above). There would also be a specific plan components to consider climate change adaptation in restoration related to reforestation (TIMB-FW-GDL-02), post-disturbance forest ecosystems (TERR-CES-GOAL-01i), arid shrublands and woodlands (TERR-PINY-DC-01; TERR-PINY-GOAL-01f; TERR-SAGE-GOAL-01f), and a management approach that addresses native vegetation:

> Promote native vegetation (e.g., conifers, aspen, shrubs) in complex early-seral habitat that supports long term ecosystem integrity considering climate change, drought, insects, disease and fire.

Restoration in alternative B would have some benefits to ecologically important species that have a high vulnerability to climate change, such as aspen and whitebark pine. The restoration of special habitats, unique vegetation types (like aspen), and whitebark pine stands would increase and there would be specific direction to improve management of these unique ecological communities. The greater use of wildfire managed to meet resource objectives would likely improve conditions for aspen and whitebark pine because they respond positively to mixed-severity fires.

Climate vulnerability assessments provide useful insights in the regional impacts of climate change. In the southern Sierra Nevada, several recent vulnerability assessments are available for assessing climate change effects to terrestrial and aquatic ecosystems in the plan area (Nydick and Sydoriak 2011a, c). Alternative B incorporates at least some recommendations of these climate vulnerability assessments in planning and prioritization efforts for terrestrial ecosystems (like for whitebark pine restoration). There is a guideline that addresses consideration of refugia for aquatic and riparian species associated with small-scale special habitats that are less likely to have connected habitat (SPEC-FW-DC-04). Fewer recommendations from the Climate Vulnerability and Adaptation Strategy (Kershner 2014) to use strategies and standards to address climate change vulnerabilities for aquatic systems were incorporated. Increased meadow restoration is one area where the recommendations were incorporated. Vulnerabilities to climate change for aquatic ecosystems are already being manifested in terms of decreased water flows and increased temperature.

Alternative B would have moderate potential to reduce the risk of large wildfires, which would make areas vulnerable to weed invasion, but it also has more restoration activities such as prescribed fire and mechanical that could also make areas more vulnerable to being invaded by nonnative plants. There is specific management direction (desired conditions, guidelines, and standards) to limit the invasion and spread of nonnative invasive plants that are common to all alternatives (described above). Alternative B also incorporates objectives to restore infested areas (INV-FW-OBJ-01) that would lessen the effects of climate change on increasing invasive plant spread. However, this would not be enough to keep up with the pace of increased invasions. There is a specific management approach directed at improved understanding of effectiveness of different methods to reduce climate related invasive species spread:

> Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, nonnative species.

Alternative B uses more flexible plan direction and an adaptive planning process that allows for more streamlined plan amendments and revisions than alternative A, which requires more prescriptive and restrictive plan direction developed under the 1982 Planning Rule. In alternative B, the emphasis is on specific desired conditions at multiple spatial scales (from patches to landscapes) that allow for a wide range of site-specific actions to implement. This adaptive process that is inherent in the new planning rule provides greater potential for alternative B to monitor, learn, and adapt to rapidly changing climate.

Consequences Specific to Alternative B-modified

The consequences of alternative B-modified would be similar to alternative B, but there would be a slightly higher restoration treatment rate (specifically mechanical thinning and wildfires managed to meet resource objectives) under alternative B-modified. As a consequence, the overall adaptive capacity of montane forest stands to climate change and climate-related stressors would be marginally higher in alternative B-modified compared to alternative B. Slightly increased restoration treatment rates (about 3 percent per decade in montane forest ecosystems) would result in marginally more forest stands with increased structural heterogeneity and diversity, reduced stand densities, restoration of fire as an ecological process, enhanced watershed and ecosystem function, and other ecological benefits. As in alternative B, restored vegetation conditions in alternative B-modified would increase the adaptive capacity of terrestrial and aquatic ecosystems to respond to climate change and interacting stressors such as uncharacteristic wildfires and hotter droughts.

About 133,490 acres would be reclassified from the Maintenance or Restoration Fire Management Zone to the General Wildfire Protection Zone in alternative B-modified. Nearly all of these acres are located in lower elevations of the sagebrush vegetation type, where the primary restoration approaches will rely on methods other than wildfires managed to achieve resource objectives (prescribed burning or mechanical thinning of encroaching conifers). Although this fire management zone reclassification would not result in changes to sagebrush treatment rates, it would result in slightly fewer wildfires burning in this vegetation type in areas with potential for fire-facilitated cheatgrass invasion. The additional protection from fire-facilitated cheatgrass invasion in alternative B-modified would result in slightly more acres with proper watershed and ecosystem function, reduced vulnerability to climate-related stressors, and dynamic habitat connectivity in sagebrush ecosystems compared to alternative B.

Consequences Specific to Alternative C

Alternative C shares many of the desired conditions for forest structural heterogeneity and diversity and restoration and maintenance of key ecological processes (like fire) as alternative B. However, restrictions on reducing canopy cover and using mechanical restoration in mixed conifer and eastside Jeffrey pine forests would limit the amount of restoration of vegetation to the desired conditions. This would result in lower levels of heterogeneity. Much of the landscape would remain in the current condition of high forest density. There would be an increased emphasis on restoration using prescribed fire and wildfires managed primarily for resource benefit but the opportunities for this type of restoration would be low in most areas (except Kern Drainage as mentioned previously) because vegetation would be denser and fires harder to control. Overall there would be lower resilience of mixed conifer and Jeffery pine forests to climate change and associated stressors of drought, insects and pathogens, and high-intensity wildfire.

Because of the denser forest conditions, there would be fewer opportunities to reduce the chance of uncharacteristically large and severe wildfire and other climate-related stressors in the plan area based on the combined rates of mechanical and prescribed fire treatments and use of wildfire managed to meet resource objectives. The greater use of wildfires managed for resource objectives would be critical to reduce fuel loading and the vulnerability of forest ecosystems across large spatial scales in the southern Sierra Nevada (Meyer 2015a), especially considering the high level of mechanical constraints in the steep and inaccessible areas that occur in many parts of the analysis area (North et al. 2015). The outcome of such fires in alternative C would be larger patches of high-severity fire because vegetation would remain denser throughout much of the montane landscape.

Alternative C would restore watershed function by increasing the emphasis on priority watersheds for management actions. There would be an increased emphasis on restoration using prescribed fire and wildfires managed primarily for resource benefit; however, whether this is sufficient to reduce risk of large, high-intensity fire and improve resilience to climate change in riparian ecosystems and meadows is unknown. It is unlikely that alternative C would result in improved watershed resilience compared to alternatives B and B modified.

Alternative C would have varied benefits to ecologically important species (such as keystone species). Although there is an emphasis on species conservation in alternative C, the benefits to some special habitats and unique vegetation types that are especially at risk (like aspen and whitebark pine) may be fewer than alternatives B and B modified due to less overall restoration that could include these areas. For those aquatic species without conservation strategies or standards and guidelines, alternative C would not improve habitat conditions or decrease vulnerabilities to climate change.

Like alternatives B and B modified, alternative C incorporates some of the recommendations of recent climate vulnerability assessments (especially for terrestrial ecosystems) that would increase climate adaptation. Alternative C would similarly apply only limited recommendations for aquatic ecosystems. The objectives for meadow restoration are increased and would provide for increased climate resilience in restored meadows and for associated aquatic ecosystems, especially downstream.

For nonnative invasive plant species, alternative C would have a more limited use of mechanical treatment and would reduce risk of invasion. However, this may be outweighed by a likely increase in the amount of burned area predicted from climate change (see “Fire Trends” section).

Consequences Specific to Alternative D

Alternative D would have similar consequences to alternative B but there would be a greater amount of terrestrial, riparian and aquatic ecosystem restoration. The amount of restoration would be greater than that in alternatives B and B modified and more than double what currently occurs under alternative A (including wildfires managed for resource objectives). This would decrease the likelihood of large, high-intensity fires (see “Fire Trends” section) and increase vegetation resilience to climate change and related stressors. There may be increases in the spread of nonnative plants because of increased mechanical restoration; however, there would also be plan direction similar to alternatives B and B modified designed to reduce and limit invasive plant establishment and spread. Nonetheless, nonnative plants are likely to increase to a greater degree under alternative D than alternatives A, B, B-modified, or C.

Alternative D has the greatest potential to reduce the risk of large wildfires which would be vulnerable to weed invasion, but it also has the most restoration activities such as prescribed fire and mechanical restoration that would be vulnerable to being invaded by nonnative plants.

Alternative D has the greatest potential for short-term impacts to habitat connectivity due to the increased amount of restoration occurring in a relatively short period of time, but it provides the most reduction of risk of large, high-intensity wildfires that have long-term impacts on connectivity of forest cover. The plan components from alternatives B and B modified would reduce some of the short-term impacts by incorporating the consideration of maintaining or restoring connectivity in project design.

Cumulative Effects

There are three aspects to cumulative effects from climate change. First, there are the cumulative effects of multiple climate change adaptation strategies. Second, there are cumulative effects of management across different adjacent ownerships. These interact with cumulative effects of climate change over time.

The cumulative effects of climate change and climate-related stressors (such as uncharacteristically large and severe wildfire, insect outbreaks, and nonnative invasive species) can be substantial to ecosystems in the plan area. The incorporation of multiple or many climate adaptation strategies may synergistically build greater adaptive capacity than the application of a few approaches. Adaptation strategies that increase climate resilience across larger areas in more vulnerable ecosystems are likely to have the greatest positive effect. This includes restoration of vegetation that reduces the likelihood of large, high-intensity fire.

Reasonably foreseeable management activities on private, State, tribal, or other Federal land would vary in the application of climate adaptation strategies. Some management activities on adjacent tribal lands, national parks, and Bureau of Land Management-managed lands would be similar, including vegetation restoration, aquatic and riparian restoration, and measures to enhance habitat resilience of species and vegetation types vulnerable to climate change. Private land owners may implement some similar actions in conjunction with Natural Resources Conservation Service programs to restore watershed health and function or improve grazing lands. These actions would increase the positive benefits of climate adaptation actions on the national forest. Conversely, a lack of restoration actions on these adjacent lands could increase the vulnerability of terrestrial, riparian and aquatic ecosystems on national forest lands because the likelihood of large, high-intensity fires and limited resilience of widespread vegetation types would persist. Coordinated efforts across all ownerships would provide the greatest cumulative positive impact on climate adaptation.

Lastly, in the foreseeable future, climate will continue the trend of increasing temperature, earlier snowmelt, and increased level of fluctuating precipitation. It is unknown whether the current drought will continue or other more severe ones will occur. The climate record suggests that this is possible although when or how long is uncertain.

Analytical Conclusions

Based on the climate adaptation indicators and measures, alternative D, followed closely by alternatives B and B-modified, are best for achieving overarching forest management goals and objectives under climate change. Alternatives B, B-modified, C, and D share most of the same desired conditions that incorporate resilience and adaptation to climate change. They all emphasize an all lands approach to management, encouraging partnerships with a wide variety of public groups, communities, and government agencies. These will increase the likelihood of a successful outcome of the application of climate adaptation strategies.

Alternative D has the greatest flexibility in the amount of vegetation restoration that would reduce the impacts of high-intensity fire, drought, and warmer temperatures on vegetation. Alternatives B and B-modified have increased flexibility to conduct vegetation restoration landscape areas and has the potential to double current levels of restoration largely due to greater opportunities to manage wildfires for resource objectives. However, alternative D proposes the highest amount of restoration compared to alternatives A, B, B-modified, and C. Although alternative D results in greater potential to increase current non-climate stressors on ecosystems related to management activities (such as reducing habitat connectivity in the short term compared to the current condition), it moves the most area toward the vegetation natural range of variation over time and provides for the most dynamic habitat connectivity in the long term by increasing the resilience of vegetation to disturbance. In contrast, alternatives B, B-modified, and C contribute less to non-climate stressors on ecosystems in the short term and maintain current habitat connectivity. However, these two alternatives would have more areas at risk to dynamic habitat connectivity because of continuing high risks of large, high-intensity wildfires.

Alternatives A and C have the least flexibility in vegetation management and the least area planned for restoration. Both alternatives emphasize conservation of moderate to high density canopy cover in late seral forest habitat and would result in retention of dense vegetation conditions that have low resilience to large, high-intensity fires, drought and temperature increases. Desired results in terrestrial ecosystems and watersheds would be achieved more rapidly in alternatives B, B-modified, and D, but potentially at greater short-term impacts to habitat for at-risk species than alternative C and possibly alternative A.

Aquatic and Riparian Ecosystems

Water Quality, Water Quantity, and Watershed Condition

Background

This section summarizes the current hydrological environment and soil conditions on the Inyo National Forest and the consequences of implementing the revised plan or its alternatives. Water originating on the national forest supplies municipal water and produces electric power to Los Angeles flowing through the Los Angeles Aqueduct (Water and Power Associates). Stream flows within the national forest provide recreational opportunities for locals and visitors. Water is integral for ecological sustainability. Streams, lakes, springs, and their associated riparian areas are relatively rare and important habitats on the Inyo. The Owens, South Fork of the Kern, and Middle Fork of the San Joaquin Rivers originate on the Inyo National Forest. The watersheds of these rivers contain meadows and corridors of riparian vegetation that provide wildlife habitat, recreational opportunities, and function to store and release water year round. The quality and quantity of water is of critical importance because these watersheds provide water for use by millions of agricultural, residential, and industrial users downstream. The waters from the southern Sierra Nevada are essential for population centers ranging from small communities like Lee Vining, east of Yosemite National Park, to metropolitan areas like Bakersfield and Los Angeles.

For the purposes of analysis, overall watershed conditions are described in terms of 10,000 to 40,000-acre watersheds called HUC-12 watersheds.[24] The Inyo National Forest contains all or part of 132 HUC-12 watersheds within the Kern River, Owens River, San Joaquin River, Mono Lake basin and several terminus lake beds in Nevada.

Streams and rivers are used for water supply, irrigation, transportation, hydropower, waste disposal, mining, flood control, timber harvest, and recreation. Many of these uses have a long history on the national forest and have made aquatic and riparian systems the most altered and impaired habitats of the Sierra Nevada. As the population of California has grown, so has the demand for water, leading to a potential for greater diversion and de-watering within Sierra Nevada hydrologic systems.

The Sierra Nevada ecosystem produces approximately $2.2 billion in commodities and services annually and water accounts for more than 60 percent of that total value (Hunsaker, Long, and Herbst 2014a). For more detailed information on water conditions see the assessments for the Inyo National Forest (USDS FS 2013a).

Analysis and Methods

The analysis evaluates and compares estimated future conditions for each alternative to the desired conditions. The indicators, measures, and assumptions described below are used to evaluate how the alternatives move toward desired conditions, and identify potential consequences from management actions across the Inyo National Forest. The indicators are used to predict future conditions related to water resources and overall watershed condition under the five alternatives.

The qualitative analysis is based primarily on the best available scientific information derived from the forest assessments (USDA Forest Service 2013a), the Bio-Regional Assessment (USDA Forest Service 2013d), the Science Synthesis (Long et al. 2014c) and recent reports and publications that assess current conditions and trends in conditions. In particular, soil and water best management practices monitoring data were reviewed to evaluate the effectiveness of current constraints on management actions. In addition, watershed condition assessments using the Forest Service Watershed Condition Framework were examined for the Inyo National Forest to assess the existing watershed condition ratings and identify restoration opportunities. Since the Watershed Condition Framework is composed of various indicators, each alternative was evaluated on how it would likely effect three key indicators (water quality, water quantity, and watershed condition). Stream condition inventory monitoring and assessment data and State 303(d) listing information were also examined where available to evaluate restoration opportunities across the national forest.

[24] HUC-12 refers to “hydrologic unit code” 12, which indicates a very large-scale watershed. As watersheds decrease in size and are nested as subwatersheds, the hydrologic unit code number decreases.

Indicators and Measures

This analysis uses three indicators: Water quality, water quantity, and the overall watershed condition. These indicators are evaluated over two general time periods to compare and contrast how the different alternatives would affect the aquatic resources.

- Short-term impacts generally run for 1 to 5 years after an event
- Long-term impacts generally run from 5 years through the life of the plan

Water Quality

Water quality may impact the health of aquatic habitat, as well as other beneficial uses of water as defined by the State Water Resources Control Board (SWRCB 2015). The two most critical parameters with the potential to influence water quality at the landscape scale or be influenced by climate change are sediment loading and water temperature (Hunsaker and Neary 2012, Neary et al. 2005, Young et al. 2009). Other water quality parameters such as nutrient inputs (like nitrogen and phosphorus), metals, and bacteria (such as *E. coli)* are also a concern to water quality but are best addressed at the project level considering requirements of the Clean Water Act.

Water Quantity

Water quantity refers to the timing, overall distribution, and volume of water produced from forest watersheds, and includes both surface and groundwater resources. Water quantity is largely dependent on the amount, type, and timing of precipitation. Soil conditions and impervious surfaces affect how precipitation is distributed, whether through runoff or ground infiltration. Shallow groundwater recharge and storage redistributes the water not captured by plant roots as streamflow, and as springs and seeps.

Watershed Condition

In March 2011, the Forest Service assessed the condition of National Forest System lands for all HUC-12 watersheds, including 132 on the Inyo National Forest,[25] using standardized protocols (Potyondy and Geier 2011). In 2015, the Forest reassessed 12 HUC-12 watersheds based on changed conditions in these watersheds. This watershed condition classification system, known as the Watershed Condition Framework, uses 12 indicators consisting of attributes related to watershed processes. The indicators and their attributes are surrogate variables representing the underlying ecological functions and processes that affect soil and hydrologic function. The indicators include water quality, water quantity, aquatic habitat, aquatic biota, riparian and wetland vegetation, roads and trails, soils, fire regime or wildfire, forest cover, rangeland vegetation, terrestrial invasive species, and forest health. Each indicator consists of one or more attributes and is assigned a weighted score. The overall watershed rating is based on amalgamated values of these attributes and indicators.

For the majority of the indicators, the Forest Service can take direct action that can contribute to maintaining or improving watershed condition, integrity and functionality. This provides a direct linkage between the classification system and management or improvement activities the Forest Service conducts on the ground (USDA Forest Service 2011d). The watershed condition framework and the Forest Service Manual (FSM 2521.1) use three classes to describe watershed condition and the condition is related to geomorphic, hydrologic, and biotic integrity and their functioning relative to their natural potential. Following are three watershed condition class ratings:

[25] http://www.fs.fed.us/biology/watershed/condition_framework.html

- Class 1 watersheds are considered to be functioning properly
- Class 2 watersheds are considering to be functioning at risk
- Class 3 watersheds have impaired function

Assumptions

There are several assumptions about ecological restoration and how different management tools may affect water quality, water quantity, and overall watershed condition that are described in the assumptions section in the “Aquatic and Riparian Ecosystem Integrity” section. There are some additional assumptions that inform this analysis as well.

Water Quality

- Projects developed under all alternatives would implement established best management practices to protect soil and water quality (USDA Forest Service 2011d, 2012b). Based on results of past monitoring, best management practices are expected to reduce both short- and long-term adverse impacts to less than significant levels. The Forest Service would continue to follow agency direction to implement an annual best management practices evaluation and adaptive management program. These results would then be reported to the jurisdictional Regional Water Quality Control Boards.
- The Forest Service would continue to work with the jurisdictional Regional Water Quality Control Boards to identify management strategies to address current 303(d) watersheds, and sources of non-point source pollution and develop total maximum daily load (TMDL) listings. Projects would comply with requirements of the Clean Water Act.
- The Forest Service would continue the transportation analysis planning process to systematically identify and address segments of roads that are causing impairment to hydrologic function or causing accelerated erosion.
- The Forest Service would continue to pursue opportunities to retrofit, relocate, or decommission roads and trails to reduce potential sediment transport to rivers and streams, especially within priority watersheds as outlined in watershed restoration action plans. System trails are currently undergoing a similar assessment and retrofit program, but are not considered to present the same degree of water quality threat as the road network because of their relatively small footprint.
- While uncertainty surrounds the degree of climate changes, observed warming air temperatures combined with fire suppression and insect outbreaks have changed fire behavior, creating the potential for increased size, intensity and frequency of wildfires, and observed increases in water temperatures during late summer and this is expected to continue (Null et al. 2013, Knowles and Cayan 2002).
- Some management activities and national forest infrastructure such as mechanical vegetation management treatments, roads, campgrounds, and grazing management have the potential to cause both short- and long-term adverse impacts to water quality that are evaluated and mitigated at the site-specific project level when projects are proposed and designed. A discussion of possible effects to water quality from the different alternatives is found in the “Environmental Consequences” section on page 267.
- Forest Service restoration activities, such as landslide stabilization, road decommissioning, stream channel, floodplain, and meadow restoration reduce sedimentation, and restore resiliency to watershed processes that affect water quality.

- Shallow groundwater serves as a filtering system for surface water and helps maintain beneficial temperatures for native fish.

Water Quantity

- The quantity of shallow groundwater is reduced under drought conditions and where infiltration is limited by development or hydrophobic soils, which occur in areas of high burn intensity after wildfire.
- The Inyo contains portions of the following recognized groundwater basins: Mono Valley, Adobe Valley, Long Valley, Owens Valley, Saline Valley and Rose Valley. The alternatives considered in detail would not affect use of groundwater in these basins.
- The Forest Service would work with the states of California and Nevada regarding regulated water rights, particularly during periods of drought.
- Meadow restoration activities would help regulate and extend the season of water flows, and may help mitigate climate change effects as flows become more erratic and the season for ephemeral flows changes.
- Climate predictions include increased warming, less snowpack, and earlier spring snowmelt. These changes would influence the amount of water supply that can originate from national forest lands and from precipitation.
- Climate changes, especially where rain precipitation replaces snowfall, tend to increase runoff and reduce infiltration and shallow groundwater recharge.
- The amount of impervious surface throughout a watershed affects the timing and flow characteristics because a greater area of impervious surface reduces infiltration into the soil of rain and snowmelt.

Watershed Condition

- Management direction would provide opportunities to improve watershed conditions to protect and restore the high value ecological functions of aquatic and riparian ecosystems. Restoration of terrestrial ecosystems would also improve or maintain watershed condition by increasing fire resilience, and reducing risk of large high-intensity wildfire. Under all alternatives, projects listed in the watershed restoration action plans would continue to be planned and completed within the priority watersheds.
- There would continue to be a risk of adverse resource effects associated with wildfire under each of the alternatives, which could result in degradation of overall watershed condition. The relative difference in wildfire risk between alternatives is described in the "Fire Trends" and "Fire Management" sections. It is assumed that the level of risk of adverse effects on soil and water resources can be estimated by the level of risk of catastrophic wildfire.
- Stream channel and floodplain restoration efforts planned and implemented, under all the alternatives would improve resilience to and mitigate some effects of climate change. Geomorphically stable stream channels and floodplains that exist in a state of dynamic equilibrium are better able to adjust to climate change impacts to hydrology, without resulting in adverse impacts to aquatic habitat, water quality, or water quantity.

The following table outlines the objectives for the number of acres of riparian vegetation improved; number of meadows enhanced or improved; and miles of streams restored for each of the plan revision alternatives. These numbers are the basis for the water quality, water quantity, and watershed effects analysis described below.

Table 45 Water, aquatic, and riparian restoration activities by alternative per decade

Type of Restoration	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Acres of riparian vegetation improved (MA-RCA-OBJ-01)	300-400	400-500	At least 400	400-500	500-600
Number of meadows enhanced or improved (RCA-MEAD-OBJ-01)	3-5	5-10	At least 5	20-25	5-10
Miles of streams restored (RCA-RIV-OBJ-01)	10-20	10-20	At least 10	20 - 30	10 - 20

Affected Environment

Current Conditions and Trends Common to the Inyo National Forest

Current Range Conditions: Water Quality, Quantity and Watershed Condition

As reported in the Final Inyo National Forest Assessment (USDA Forest Service 2013a), within the last 10 years, condition data has been collected from key areas on 32 allotments on the Inyo National Forest. Data include watershed condition and stream channel assessments. Stream channel assessments use the proper functioning condition (PFC) protocols (Null et al. 2013, Knowles and Cayan 2002, United States Department of Interior 2015a). Because of the various differences in rangeland types, the allotments have been grouped into similar ecosystem types to facilitate management. These groups are: Kern Plateau, Desert Allotments, Crowley Lake, Mono Lake, White Mountain, Bishop, and Inyo Mountain.

Watershed condition ratings show that 71 key areas (50 percent) rate as fully functional, 47 key areas (33 percent) rate as functioning at risk, 29 key areas (20 percent) rate as degraded and 6 key areas (4 percent) rate as non-functional. For stream reaches within grazed allotments, 67 reaches (59 percent) are properly functioning, 42 reaches (37 percent) are functioning at risk (with different trend ratings), and 5 reaches (5 percent) are non-functioning (USDA Forest Service 2017e).

While generally good, rangeland conditions vary throughout the Inyo, based on data collected to assess vegetation conditions, watershed function, and hydrologic function. The Inyo National Forest conducts annual monitoring of range best management practices to evaluate impacts to water quality and aquatic habitat. Of the total 24 range allotment evaluations conducted, 16 were rated as both implemented and effective. Another four rated as implemented at risk, meaning that although the best management practices were correctly implemented, minor departures from effectiveness were noted. The remaining four evaluations were rated implemented but not effective, meaning that although the best management practices were implemented as planned, they were not effective in preventing adverse effects on water quality (see “Production Livestock Grazing” section for additional information).

Water Quality

Overall, water quality within the Inyo National Forest is good, having benefited from restoration projects to treat legacy impacts; low population and levels of development; and because of protective standards and guidelines in the current forest plans. Water quality is directly influenced by erosion of soils, pollutants, dams, roads, and management activities associated with the national forest. Soils are influenced by erosion, compaction, pollution, and land-disturbing activities and events. Water quality on the Inyo National Forest is generally good, due to high elevation sources (USDA Forest Service 2013a, 2013d). The Los Angeles Department of Water and Power uses water from the Mono and Owens River watersheds for municipal use. Their annual water quality reports show that water quality meets all drinking water standards. Relatively few areas on the Inyo National Forest have widespread accelerated erosion beyond the natural range of variation. Erosion rates far outside of the natural range of variation have been observed mainly along roads in steep areas, in developed areas such as ski areas, and after high-intensity wildfires. While rilling and gullying are evident at Mammoth and June Mountain Ski Areas, erosion is generally limited to within the ski area boundary. Both ski areas have extensive ski run drainage systems and revegetation programs to reduce erosion (USDA Forest Service 2013a).

There are an estimated 1,985 miles of National Forest System roads on the Inyo National Forest. The estimated sediment yield from these roads is between 0.01 and 0.09 tons per acre per year. This compares to an estimated 0.0004 to 0.004 tons per acre per year from vegetation management activities (USDA Forest Service 2013d).

In the southern Sierra Nevada, fires are often observed to cause increased erosion, both from water and wind, and to a lesser extent, from dry ravel (Berg and Azuma 2007). Erosion rates as high as 30 to 44 tons per acre per year have been measured following high-severity wildfire. These high erosion rates seen after a fire typically decline within 3 to 5 years as vegetation recovers. Wildfires and soil erosion are natural processes that help shape forest ecosystems. Prescribed fire has not been shown to increase erosion in most studies, due to low fire severity that often leaves soil structure and organic matter intact. Prescribed fire has been largely successful in reducing fuels without significantly impairing soil productivity, soil stability, or the riparian vegetation which stabilizes soils (DeBano 2000; Bêche, Stephens, and Resh 2005; Pettit and Naiman 2007; Arkle and Pilliod 2010)

The effects of fire can be both negative and positive for water quality and quantity, depending upon the extent and severity of the fire. Reducing large, high-intensity wildfire is extremely important to lower total sediment yields from national forests in the Sierra Nevada drainage basins. The primary effect of large, high-severity fires on water quality is increased sediment as a result of loss of soil cover and soil organic matter, soil hydrophobicity (lack of ability for soil to absorb water), and the destabilizing of existing roads, trails, and skid trails (Neary et al. 2005, Hunsaker et al. 2013b). Large, high-intensity fires may also cause erosion and changes to the streambed that can eliminate vulnerable aquatic populations, degrade water quality, reduce capacity of downstream reservoirs, and increase the risk of flood (Long, Quinn-Davidson, and Skinner 2014b). Two recent debris flows on the Inyo National Forest occurred in watersheds that had recently burned at high severity: Oak Creek and Haiwee Canyon.

There are also beneficial effects of fire to stream and river ecosystems (such as large wood recruitment into streams) that are described more in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections. More information on fire and its effect on hydrologic function may be found in the “Fire Trends” section.

The Inyo National Forest has limited direct measurements of water temperature and sediment from monitoring. The State and Regional Water Quality Control Boards have established lists of impaired waters on or immediately downstream of the national forest using the limited data available. The 303(d) list of impaired waters reports on streams and lakes identified as impaired for one or more pollutants; the term “impaired” means these waterbodies do not meet one or more water quality standards (U.S. Environmental Protection Agency 2015). Sometimes these listings result in the establishment of a total maximum daily load (TMDL) water quality threshold and management strategy for bringing these waterbodies back into an unimpaired condition. Total maximum daily load values have not been established yet, but some have been identified as needed for these waterbodies. Impaired waters are identified through assessment and monitoring programs conducted by volunteer networks and other local, State and Federal agencies. Table 46 shows the 303(d)-listed waterbodies within or adjacent to the Inyo and the cause of the impairment.

Based on an analysis of best management practice effectiveness data collected over the past 4 years (2011 to 2014), Inyo National Forest rated 76 percent of best management practices as implemented and effective, respectively (Kelley 2015). Data collection and analysis were performed following the Pacific Southwest Region’s protocols and procedures established for best management practices evaluation program (USDA Forest Service 2001a).

Table 46. Impaired (303(d)-listed) waterbodies within or adjacent to the Inyo National Forest

	Hilton Creek	Mammoth Creek	Mono Lake	Rock Creek
Reason(s) for Listing (Pollutant)	Dissolved Oxygen (low levels)	Metals (Mn, Hg, Ar) Total Dissolved Solids (TDS)	Chlorine (Cl) (Hypersalinity)	Total Dissolved Solids (TDS)
Impairment For What Use or Benefit?)	Fish Habitat	Sport Fishing	N/A	Fish Habitat
Possible Causes / Notes	Unknown / Upstream from Crowley Lake	Natural sources (metals), mining / Flows through urbanized Mammoth Lakes	Evaporation / Downstream from Inyo / Not 303(d) listed due to special circumstances	Surface mining
Year to be Rectified	2021	unknown	Settlement w/Los Angeles Department of Water and Power	2021
Total Maximum Daily Load (TMDL) Limited	Yes	Yes	Yes	Yes

Water Quantity

The effects of climate change in the Sierra Nevada range are apparent in rising minimum temperatures, earlier snowpack melting, changing stream hydrology, and increased frequency of large, high-severity wildfires (Safford, North, and Meyer. 2012). Climate changes are also expected to change the pattern, frequency, and intensity of disturbances (Safford, North, and Meyer. 2012). The result will be increased wildfires, doubling the area burned annually by the middle of the 21st century.

There are limited results on the effects of watershed restoration on water quantity in the Sierra Nevada. Podolak et al. (2015) identified that meadow restoration had the potential to change timing of flows by quantifying the timing of flows from one meadow restoration. However, because of the lack of research on the subject they did not infer their findings to meadows across the northern Sierra Nevada. In addition, pond-and-plug meadow restoration projects completed in the Northern Sierra indicate no differences were found between pre- and post-project late season flows (Hoffman, Roby, and Bohm 2013). At best, it may be assumed that water quantity increases resulting from restoration efforts may be localized. Given the variability of seasonal and yearly fluctuations of precipitation and flow it would difficult to determine actual effects to water quantity from restoration efforts in the Sierra Nevada.

Based on patterns of large flood described previously, the frequency of large floods may be increasing. Climate predictions indicate that changes in flow patterns will stress meadows, streams, and rivers in several ways. In areas where snow is replaced by rain, the opportunity to infiltrate and recharge shallow groundwater is reduced as more precipitation immediately runs off the land. Peak flows will be earlier and more intense, possibly increasing erosion and leaving less water later in the summer (Hunsaker, Long, and Herbst 2014a). Pulses of soil erosion and flooding caused by higher rainfall intensity will increase, but the pattern will be highly variable.

Because severe wildfire often leads to high erosion rates from hill slopes and stream channels, as climate change leads to more intense and larger wildfires, the plan area as a whole will have greater erosion rates. If streams tend to dry out earlier in the summer, or formerly perennial streams become intermittent, it is likely that there will be less riparian vegetation over time. This could lead to increased streambank erosion. Potential climate change effects to nutrient cycling and organic matter in soils has not been well studied outside of agricultural systems.

Community water supply falls within the Wildland-urban Intermix Defense Zone in alternatives A and C and within the Community Wildfire Protection Zone in alternatives B, B-modified and D. The communities within and adjacent to the Inyo receive their water from a combination of groundwater and surface water sources.

Watershed Condition

The Watershed Condition Framework, completed in 2011 with an additional 12 watersheds re-assessed in 2015, provides a means to evaluate, prioritize, and measure progress of restoration across the Inyo National Forest and to evaluate alternatives (USDA Forest Service 2011d). The Inyo National Forest uses the Watershed Condition Framework to assess and classify the condition of 132 HUC-12 watersheds (typically 10,000 to 40,000 acres) in the plan area. Most drain to the San Joaquin Valley, Owens River or terminal Great Basin lakes and desert valleys. These waters have been diverted in large quantities for agricultural, municipal, commercial, and industrial uses. For example, the majority of flows into the Owens River Basin are diverted to Los Angeles via the Los Angeles Aqueduct, greatly affecting downstream flows below the Inyo National Forest boundary.

Properly functioning watershed conditions create and sustain functional terrestrial, riparian, aquatic, and wetland habitats capable of supporting diverse populations of species. As noted above, assessment of watershed condition is conducted at the HUC-12 watershed level. Watershed condition integrates the entire ecological function of a land area contained within a given hydrologic boundary. For the forest, existing assessments describe watershed condition within their administrative boundaries that are subject to management by the Forest Service and not lower watersheds and intervening areas that may be impacted by agricultural or urban development.

Management activities that affect watershed condition class ratings are not limited to soil and water improvement activities, but include a broad array of resource program areas from hazardous fuel treatments, invasive species eradication, abandoned mine restoration, riparian area treatments, aquatic organism passage improvement, road maintenance and obliteration, and others. To achieve a change in watershed condition class will in most cases require changes within a watershed that are significant in scope and include treatments from multiple resource areas.

The discussion and analysis of watershed conditions and consequences of selecting forest plan alternatives is focused on individual or aggregated effects on HUC-12 watersheds. Some adjacent HUC-12 watersheds are hydrologically connected to each other and others are not. Therefore it is possible to have one or more HUC-12 watersheds that exhibit poor ecological integrity, adjacent to highly functioning watersheds.

The condition of the HUC-12 watersheds on the Inyo National Forest is summarized in table 47. The condition class area is based on National Forest System lands contained within the HUC-12 watersheds. Private lands cover approximately 37 percent of the area within the HUC-12 watersheds shown in the table. Class 1 represents watersheds that are considered to be functioning properly. Class 2 represents watersheds considered to be functioning at risk. Class 3 represents watersheds that are considered to have impaired function.

Table 47. Number of and percentage of HUC 12 watersheds by condition class on the Inyo National Forest

Condition Class	Inyo (number)	Inyo (percentage)
Condition Class 1	118	89%
Condition Class 2	14	11%
Condition Class 3	0	0%
Total	132	100%

High fuel loads, road density, road proximity to water, invasive species, and aquatic habitat fragmentation due to dams were the most common stressors affecting watersheds that were not properly functioning, or functioning at risk.

The Inyo National Forest is focusing restoration activities within its priority watersheds to minimize past impacts of high road density, high fire risk due to bark beetle infestation, and channel destabilization caused by runoff and debris flows from high-severity wildfires. About 7 percent, or 117 miles of the 1,640 miles of perennial streams on the national forest are downstream of a dam, where flows are determined by both natural precipitation and runoff, and the operations of these dams. As noted in table 47, the Inyo National Forest does not have any watersheds assessed as impaired but 14 are considered at-risk watersheds.

Environmental Consequences to Water Quality and Quantity, and Watershed Condition

This section evaluates how the five alternatives considered in detail affect water quality, water quantity, and watershed condition based on the pace and scale of ecological restoration and plan components. Consequences common to all the alternatives are described first, followed by consequences specific to each alternative.

Consequences Common to All Alternatives

Water Quality

The key water quality indicators are temperature and sediment loading since these factors are critically important to aquatic species and the overall health of the aquatic system (see "Aquatic and Riparian Ecosystem Integrity" section). Climate change will alter the overall hydrologic regime in the Sierra Nevada. The higher ambient air temperatures will cause earlier peak flows and lower base flows in the summer and fall throughout the southern Sierra Nevada. All alternatives seek to mitigate these effects through restoration to maintain or reduce water temperatures and prevent erosion for the benefit of native fish and other species.

The Inyo National Forest and its partners are actively implementing restoration actions to reduce erosion on roads, trails, dispersed camping areas, grazed areas, and other developed and dispersed recreation sites. These efforts are expected to continue, further reducing erosion on the forest. Water quality would be improved where the Forest Service and partners actively restore watersheds.

Water quality in 303(d)-listed streams, shown in table 46 on page 265, is likely to be unchanged except where restoration has occurred and the contaminant is within control of Forest Service management. Sources of contaminants, such as mercury, manganese and arsenic and that have caused 303(d) impairment to streams are from geologic or legacy sources that are not a result of Forest Service management.

All alternatives maintain the same level of livestock grazing as the 1988 Land and Resource Management Plan (alternative A), as amended (USDA Forest Service 1995b, 2001, 2004). There would be no change to existing management direction for livestock grazing. Current management direction for term grazing permits and allotment management plans remain in place. New permits and management plans would follow direction identified in the Inyo Forest Plan, chapter 2 Rangeland Livestock Grazing. Forest plan direction includes grazing management in meadows (MA -RCA-STD-10-14 and 17; MA-RCA-GDL-03, 05 and 07). These standards and guidelines and others (RANG-FW-STD-01-07) while not new, are anticipated to improve grazing management, and result in positive meadow and water quality trends over time, especially as the forest continues to implement riparian and range improvement projects.

Water Quantity

Climate change will alter timing and distribution of runoff and infiltration to recharge shallow groundwater, which affects stream flow and downstream agricultural, municipal, and industrial users of both surface water and groundwater. Warming air temperatures will bring about less snowfall, more intermittent snowpack at all but the highest elevations, more rain-on-snow events, reduced spring snowmelt, earlier and likely lower peak spring runoff, and higher evapotranspiration rates for vegetation (Podolak et al. 2015). These impacts reduce snow melt timing and quantity which reduce the effectiveness of precipitation to refresh shallow groundwater, and in turn stream flow. As less snow is stored on the landscape, higher evapotranspiration returns more water to the atmosphere, and as the period in which snowmelt is available is reduced and shifts to earlier in spring rather than distributed over many months, overall water quantity is reduced resulting in reduced percolation into shallow groundwater storage, and reduced baseflow in streams that are groundwater dependent (Bales et al. 2011). Climate change will tend to reduce the overall quantity of water produced by the Sierra Nevada affecting both on-forest and downstream beneficial uses.

All alternatives would work toward ecological restoration and attempt to mitigate effects of climate change at varying scales across the national forest. All alternatives include both removal of vegetation through hand thinning, mechanical treatments, prescribed fire, and wildfire managed to meet resource objectives. The use of fire to restore landscapes in the Sierra Nevada is a key part of all alternatives and has been used for centuries by Sierran Tribes to maintain flow from springs and streams among other benefits (Parrotta and Trosper 2011, Anderson 2006).

Taking action to improve or maintain watershed condition will make the Inyo more resilient to climate change (reducing fuel loading in high fire risk areas, restoring meadows and stream channel function). As the Inyo National Forest, within the bio-region increases the pace and scale of restoration, including mechanical tree thinning and managed fire, the national forest should become more resilient to climate change.

No change is expected to water quantity given implementation of forestwide watershed and grazing plan components which are unchanged from current direction and common among all alternatives.

Watershed Conditions

The Inyo National Forest has identified priority watersheds to focus work in such a way that produces overall benefits to a watershed, rather than restoring disparate locations throughout the national forest. For all priority watersheds, the forest has developed water restoration action plans, which identify essential projects to restore sites with legacy erosion and degraded aquatic and riparian habitats, such as streams and meadows. The watershed restoration action plans provide managers with a list and schedule of projects to be completed and are designed to improve the condition class rating of priority watersheds. As Inyo staff completes these essential projects, they evaluates the watersheds to determine whether the projects achieved their goals and track and report projects through national agency databases such as the Watershed Improvement Tracking (WIT) and Watershed Condition and Assessment Tracking Tool. The staff develops funding strategies, focuses resources, and develops appropriate partnerships to complete the identified projects to maintain or enhance the watershed.

The forest plans do not determine the development of new priority watersheds. Instead, watershed managers use the watershed condition framework process to recommend new priority watersheds to appropriate-level responsible officials after assessing need to restore degraded aquatic and riparian habitats. Recommendations are based on national forest inventory and monitoring data and factors such as interest and availability of partners, the presence of a listed or species of conservation concern, and the risk of large, high-intensity wildfire. Managers will also consider watersheds already identified for fuel reduction and other ecological restoration. As new priority watersheds are selected, essential projects are identified in watershed restoration action plans.

Although Forest Service budgets are expected to stay relatively static, with limited funding available to meet all the restoration needs currently identified on the national forest, there are increasing opportunities for projects to restore watersheds through State water bond grants and other funding. There are a variety of partners interested in applying for grants to accomplish work on National Forest System lands. The Inyo has a substantial list of potential projects that are ready to begin or are being planned for implementation once funding is available. These projects are currently listed in the Watershed Improvement Tracking database, and can easily be incorporated into watershed restoration action plans as new priority watersheds are selected. The Forest Service anticipates that such partnerships would compete well for these and other State funding for potential projects that benefit watershed condition on the national forest.

The monitoring data shows that conditions in grazing allotments are generally improving based on historical ratings. We expect no change to slight improvement to watershed condition indicators for riparian/wetland condition (5) and rangeland vegetation (10) because we are not changing existing management direction for livestock grazing.

Consequences Specific to Alternative A

Alternative A continues the current objectives for reducing fuel loading covering approximately 10 to 15 percent of the lands needing this treatment to substantially reduce the risk of large high-intensity wildfires. The priority for treatment is within the Wildland-urban Intermix Defense and Threat Zones and upland areas with road access and on low to moderate slopes where mechanical equipment can operate safely with minimal ground disturbance. The amount of fuel reduction work completed under the existing forest plans is not sufficient to reduce the threat of large high-intensity wildfire, so the potential to maintain or enhance watershed condition remains low (see “Terrestrial Ecosystems” section). Alternative A does not change the pace and scale of terrestrial restoration and retains the restrictive and prescriptive standards and guidelines in the current forest plan. While these standards and guidelines serve to protect water quality and watershed function in areas where projects occur over the short term, the pace and scale is not sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Since climate change is likely to increase the risk of high-intensity wildfire, the overall impact on water quality and watershed function would decline under alternative A. The development of fixed width riparian conservation areas and associated standards and guidelines in the current forest plans has provided an effective level of protection to water quality throughout the Southern Sierra Nevada. The riparian conservation areas have resulted in reduced soil disturbance and erosion in areas of highest risk of sediment entering a stream.

The current plans also have the critical aquatic refuges as described in the “Aquatic and Riparian Ecosystems” section. Critical aquatic refuges can be areas of focused restoration when needed for species conservation and water quality improvement. The Inyo completed restoration work in several critical aquatic refuges over the past 10 years. Where roads are used for management actions, managers would look for opportunities to maintain, repair, reroute, or improve aquatic organism passages across them through stewardship or partnership opportunities.

Water Quality

Alternative A maintains current riparian conservation areas and standards and guidelines from the current forest plans. Short-term sediment impacts from continuing at the current pace and scale of restoration would remain nearly the same. However, long-term indirect impacts would be greater from trends of increasing wildfire frequency and fires that burn with higher intensity (see “Terrestrial Ecosystems” section). Ecological restoration reduces fuel loading and tends to have a dampening effect on wildfire intensity. Wildfire behavior would be less constrained by fewer treated acres, be expected to grow larger and burn at higher intensity, and may affect multiple watersheds. Within the burned areas, these types of fires destabilize hillslopes and stream channels, consume surface litter that protects the soil, and create hydrophobic soils that can significantly limit infiltration and increase runoff. These effects can cause accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Water Quantity

Alternative A would continue to contribute to reduced flows due to higher evapotranspiration rates of dense forests over broad landscapes, exacerbated by lower precipitation and higher temperatures from climate change. The decrease of winter snowpack and increased proportion of rain verses snow reduces the infiltration and increases runoff compared to the past. This would potentially cause earlier peak flows, lower late spring and early summer runoff, and lower baseflows during the dry season. After high-intensity wildfires greatly reduce vegetation, ground cover, and evapotranspiration, runoff spikes are further amplified by the reduction of infiltration by hydrophobic soils, for the short term. This runoff carries a high potential for downstream flooding, soil erosion, and sediment loading of streams. The overall annual yield of surface water is likely to be lower and more difficult to manage and store for beneficial downstream uses (Bales et al. 2011).

Shallow groundwater would also potentially be reduced due to maintaining the current pace and scale of terrestrial and meadow restoration combined with climate change effects. Deep percolation through the soils would be reduced by evapotranspiration in unburned and untreated areas and infiltration would be reduced where high-intensity wildfire causes hydrophobic soils.

Water quantity reductions may be mitigated where forest managers actively restore the watersheds. Since the current forest plan does not limit watershed restoration, the pace and scale may increase as new opportunities and funding sources evolve and partnerships are enhanced to complete watershed restoration projects. Shallow groundwater recharge would increase only where meadows have been restored, but generally would decline overall due to the relatively low pace of restoration.

Watershed Conditions

Alternative A emphasizes restoration activities within priority watersheds to maintain or improve watershed conditions. Under the current forest plan, additional watershed restoration occurs in areas where mechanical thinning occurs and stewardship opportunities exist. Additional sources of funding and assistance through partnerships could be used to improve watershed conditions throughout the Inyo National Forest. Riparian and aquatic habitat restoration help offset effects of climate change on stream temperatures, better maintain base flows, and can enhance riparian condition. However, overall watershed conditions would continue to be at risk from high-intensity wildfire and legacy impacts.

The existing forest plan contains specific standards and guidelines and implements best management practices to protect soils on steep slopes, especially within the riparian conservation area. The critical factors to maintain and enhance soils productivity are to minimize soil disturbance and compaction. Alternative A maintains the current pace and scale of ecological restoration and all riparian conservation area protections in the current plans.

The existing critical aquatic refuges were created to protect and enhance habitat for aquatic species. Alternative A would not add new critical aquatic refuges and would continue to minimize ground-disturbing activities within them.

Alternative A is not likely to adequately address watershed condition indicators such as water quantity, fire regime, forest cover, and forest health issues such as tree mortality and insect infestation over the long term, because these require an increase in pace and scale of terrestrial restoration to moderate the risk of large high-intensity fire at a landscape scale. Riparian area conditions may also decline over time due to increased risk of high-intensity wildfire within the riparian conservation areas.

Consequences Specific to Alternative B

Alternative B proposes to double ecological restoration across the Inyo National Forest compared to alternative A and would treat 15 to 30 percent of areas identified as needing this treatment to substantially reduce the risk of high-intensity fire. These treatments are expected to reduce the likelihood of large high-intensity fire compared to current conditions under alternative A but there would still be an increasing trend in large high-intensity wildfires due to climate change (see “Fire Trends” section).

The development of fixed width riparian conservation areas and associated standards and guidelines in the current forest plans has provided an effective level of protection to water quality throughout the Southern Sierra Nevada. The riparian conservation areas have resulted in reduced soil disturbance and erosion in areas of highest risk of sediment entering a stream. These would be carried forward, with flexibility to adjust the widths based on project analysis.

This alternative contains critical aquatic refuges as described in the “Aquatic and Riparian Ecosystems” section. Critical aquatic refuges can be areas of focused restoration when needed for species conservation and water quality improvement. The Inyo completed restoration work in several critical aquatic refuges over the past 10 years. Where roads are used for management actions, managers would look for opportunities to maintain, repair, reroute, or improve aquatic organism passages across them through stewardship or partnership opportunities.

Water Quality

Alternative B requires the use of best management practices in project design and implementation that are effective in reducing soil erosion and sediment delivery to streams in order to protect watersheds. The southern Sierra Nevada has large areas where steep slopes and unconsolidated granitic and pumice soils are common. However, alternative B maintains the riparian conservation areas of generally fixed widths, which can be adjusted on a project-by-project basis. These riparian conservation areas have proven effective at reducing soil disturbance and erosion in critical areas near special aquatic features such as streams, lakes, wetlands, fens and springs.

The proposed use of best management practices, standards, and guidelines in project design and implementation would be effective in reducing soil compaction, erosion, and sediment delivery to streams to protect watersheds. Short-term sediment impacts from increasing the pace and scale of restoration would likely be slightly higher than alternative A but project implementation of best management practices, standards, and guidelines should minimize impacts to water quality.

Although alternative B emphasizes fire’s role in restoring ecological integrity to the landscape and would moderate the upward trend of wildfire frequency and intensity, the effects of climate change and insect and disease outbreaks over the long term would increase the risk of high-intensity wildfire over current conditions. The emphasis on restoring low- and medium-intensity fires across the landscape (including within riparian areas) would limit the accumulation of fuels, restore understory plants of cultural importance to Sierra Tribes, and encourage vigorous riparian habitats. The long-term potential for indirect impacts of sediment delivery to streams is lower than alternative A. High-intensity fires are trending larger and may affect entire or multiple watersheds. Within the affected areas, these fires destabilize hillslopes and stream channels, consume surface litter that protects the soil, and create hydrophobic soils that can significantly limit infiltration and increase runoff. It is these effects that contribute to accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Temperature may be improved due to slightly higher base flows caused by lower evapotranspiration on the restored uplands adjacent and upstream from affected stream reaches. Restoring meadows would help regulate downstream flows and store water under the surface where it maintains cooler temperatures. Riparian plants shade streams and would be restored or protected to cool streams. Fuel reduction treatments would reduce the potential for high-intensity wildfires. Reducing the risk that high-intensity wildfires would kill vegetation, particularly within riparian areas, would maintain cooler water temperatures by providing more stream shade (Westerling et al. 2006). This is more important considering the expected higher air temperatures (see “Fire Trends” section). Restoration of riparian areas and meadows, combined with upland reintegration of fire into the landscape, would likely enhance greater infiltration and recharge shallow groundwater. Greater groundwater recharge and storage increases baseflow of surface water across the landscape and tends to lower water temperatures during the dry season, which provides habitat for aquatic species and water sources for terrestrial species (see “Aquatic and Riparian Ecosystems” section).

Water Quantity
Climate change is likely to reduce effective precipitation. Deep percolation through the soils is reduced by evapotranspiration in unburned and untreated areas and infiltration is reduced where high-intensity wildfire has caused hydrophobic soils. Overall, shallow groundwater recharge and storage is likely to be slightly reduced compared to current conditions due to climate change. Alternative B would help somewhat to maintain shallow groundwater recharge and storage under warming climate conditions.

Mechanical thinning of trees and low-intensity underburning of vegetation would reduce evapotranspiration and maintain, slightly increase, or extend the timing of stream flows (Hunsaker et al. 2014). Alternative B would treat more area than alternative A, and combined with more meadow restoration could increase infiltration on a landscape scale, thereby providing more groundwater recharge and storage. Increased shallow groundwater storage potentially mitigates some of the impacts from climate change and increases aquatic system resilience, stabilizes stream flows, and benefits wildlife dependent on springs.

Watershed Conditions
Alternative B would address watershed condition factors such as water quantity, fire regime, forest cover, and some forest health issues because of the increased pace and scale of terrestrial restoration at a landscape scale. Riparian conditions may improve due to less risk of high-intensity wildfire within riparian conservation areas, but not as much as alternative D.

Alternative B proposes a new critical aquatic refuge for the benefit of the black toad on the Inyo National Forest. The opportunity to focus restoration within existing critical aquatic refuges to benefit species would be the same as alternative A. The additional critical aquatic refuge in alternative B is outside of areas to be actively managed so impacts would be similar to alternative A.

Riparian areas are likely to be maintained as restoration activities proceed within riparian conservation areas in the short term and improve over the long term compared to alternative A. This is because ecological restoration of adjacent uplands could benefit riparian structure where native species occur. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to riparian areas for alternative B.

Soils may be impacted more in the short term due to ground disturbance during restoration activities when compared to alternative A, but would improve over the long term where restoration has reduced the risk of high-intensity wildfire. The critical factors that maintain and enhance soil productivity are to reduce soil disturbance and compaction. The increased pace and scale of ecological restoration, especially using ground-based mechanical equipment, causes soil disturbance and compaction. Infiltration is reduced on compacted soils and tends to run off and increase erosion. The riparian conservation areas and equipment exclusion zones are designed to limit soil disturbance adjacent to streams and to provide filter strips to capture erosion from adjacent uplands. These filter strips have proven effective in preventing sediment delivery to streams and protecting aquatic species such as salamanders (Olson 2015). Alternative B would maintain similar riparian conservation area protections and requires the use of best management practices to reduce soil compaction and erosion. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to soil sustainability for alternative B.

The likelihood of large high-intensity fires would continue to increase but at a lower rate than in alternative A. As a result, alternative B fuel reduction work would provide benefits to maintaining water and soil quality, and watershed condition over the long term. As the pace and scale of restoration is increased, including mechanical tree thinning and managed fire, the forests should become more resilient to climate change than alternative A.

Consequences Specific to Alternative B-modified

Overall, alternative B-modified has a similar set of consequences as described in alternative B for water quality, quantity and watershed conditions. The primary difference between alternatives B and B-modified is that critical aquatic refuges are not brought forward and, instead, are replaced by conservation watersheds.

Alternative B-modified proposes approximately the same amount of acres of wildfire managed to meet resource objectives reducing the risk of high-intensity fire, treatment of nonnative invasive plants (INV-FW-OBJ-01) and the amount of acres of sage-grouse habitat maintained, improved or restored as alternative B. As in alternative B, these treatments are expected to reduce the likelihood of large high-intensity fire compared to current conditions under alternative A; however, there would still be a trend increase in large high-intensity wildfires due to climate change (see “Fire Trends” section).

Under alternative B-modified, riparian conservation areas remain the same as in alternative B. However, critical aquatic refuges are not brought forward in this alternative. Under this alternative, areas that are no longer critical aquatic refuges and those areas that are outside of riparian conservation areas would be managed following forestwide terrestrial ecosystem and vegetation, watershed, and other applicable forestwide direction, as well as applicable management area or designated area direction.

Conservation watersheds are management areas that represent long-term prioritization for maintenance and restoration so as to provide for the persistence for at-risk species and maintain functioning conditions of the watershed, which provide for high quality water for beneficial uses. In principles outlined in the Watershed Condition Framework, the Forest Service has provided national direction to protect high quality watersheds already in good condition first, then maintain the condition of watersheds to keep them from becoming threatened. After actions to maintain class 1 watersheds, the forest focuses on restoring watersheds identified as functioning at-risk. Desired conditions for conservation watersheds are for high-quality habitat and functionally intact ecosystems, which in turn improves the quantity and quality of water available to improve aquatic systems and to be available for other beneficial uses.

Conservation watersheds are intended to be a network of watersheds which have been determined to have a functioning or functioning at-risk rating based on the Watershed Condition Framework. As presented on the Watershed Condition Framework map, the majority of all at risk watersheds are located outside of the conservation watersheds. An at-risk watershed (Soda Creek-South Fork Kern River), located on the South Fork Kern River Headwaters conservation watershed, is rated as such, due to poor riparian wetland vegetation conditions, poor aquatic habitat and poor forest health conditions (see Development of Conservation Watersheds for the Inyo National Forest 2017, project record).

The four proposed conservation watersheds are located almost entirely within wilderness areas. Total acres proposed for the four conservation watersheds is approximately 387,000 acres. Approximately 77 percent, or about 298,000 acres, are located within wilderness or inventoried roadless areas (see conservation watershed map appendix A, Land Management Plan Inyo National Forest, 2018). Names and acreages of these conservation watersheds are shown in table 51. The Forest Service manages wilderness areas for natural process to occur with minimal development. Generally, wilderness areas provide for high quality habitat and water quality given the nature of the land designation and lack of development.

Alternative B-modified proposes a zone concept and incorporates recreation opportunity spectrum (ROS) in place of recreation places (alternatives B, C and D) to manage for sustainable recreation. The recreation zones include Destination Recreation Area, General Recreation Area and Challenging, Backcountry Recreation Area. Conservation watersheds do not restrict development of additional recreation infrastructure contained mostly within the General Recreation Area. There are approximately 47,734 acres (12 percent) of General Recreation Area outside of riparian conservation areas (most likely areas of additional development) within the 4 conservation watersheds. The South Fork Kern River 12,494 acres (7 percent) and the Mono Lake Headwaters 11,067 (12 percent) contain the most acres of General Recreation Area. Forestwide watershed plan components in addition to specific conservation watershed components will ensure protection of water quality and water quantity and specific Watershed Condition Framework indicators.

When implementing watershed improvements, motorized equipment may not be used in wilderness areas to accomplish improvement objectives unless a Minimum Requirements Decision Guide analysis is completed to demonstrate the need. The Inyo has aggressively implemented meadow and stream restoration in degraded areas within wilderness areas, though mostly within the Golden Trout Wilderness.

Water Quality

Development of conservation watersheds for the Inyo National Forest (located in project files in the Inyo National Forest Supervisors Office) displays Watershed Condition Framework indicator ratings for the four proposed conservation watersheds. This information indicates that under the current plan, alternative A, water quality in the proposed conservation watersheds is rated “good.”

All alternatives require the use of best management practices in project design and implementation. Best management practices have proven to be effective in reducing soil erosion and sediment delivery to streams. The continued use of best management practices, standards, and guidelines in project design and implementation would be effective in reducing soil compaction, erosion, and sediment delivery to streams to protect watersheds. Short-term sediment impacts from increasing the pace and scale of restoration and increasing the amount of acres of wildfires managed to meet resource objectives would likely be similar to alternative B in the short term but provide for a decrease in the potential for a stand-replacing wildfire and associated impacts to water quality in the long term. Project implementation of best management practices, other plan components, and the use of resource advisors and applying Minimum Suppression Impact Techniques (MIST for wildfires) should minimize impacts to water quality.

Although alternative B-modified emphasizes fire's role in restoring ecological integrity to the landscape and would moderate the upward trend of wildfire frequency and intensity, the effects of climate change and insect and disease outbreaks over the long term increase the risk of high-intensity wildfire over current conditions. The emphasis on restoring low- and medium-intensity fires across the landscape (including within riparian areas) would limit the accumulation of fuels, restore understory plants of cultural importance to Tribes, and encourage vigorous riparian habitats. The long-term potential for indirect impacts of sediment flows to streams is lower than alternative A and similar to alternatives B and D. Within the affected areas, these fires destabilize hillslopes and stream channels, consume surface litter that protects the soil, and create hydrophobic soils that can significantly limit infiltration and increase runoff. It is these effects that contribute to accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Alternative B-modified maintains best management practices, riparian conservation areas, and forestwide watershed, fire, terrestrial ecosystem and vegetation direction similar to alternative B. Management direction for conservation watersheds provides further emphasis and support for maintaining water quality within the four established conservation watersheds. Although this direction differs from critical aquatic refuges, water quality direction under critical aquatic refuges was limited to smaller acreages, or watersheds, unlike the larger, landscape-scale of conservation watersheds. Conservation watersheds allow for the use of fuels treatments and use of wildland fire to meet resource objectives, which allows for the continuance of long-term positive impacts to water quality.

Water Quantity

Development of conservation watersheds for the Inyo National Forest (on file at the Supervisors Office) displays Watershed Condition Framework indicator ratings for the four proposed conservation watersheds. This information indicates that under the current plan, alternative A, water quantity is rated good in three of the four conservation watersheds. In the Mono Lake Headwaters conservation watershed, three watersheds are rated being poor and two in fair condition. Lee Vining Creek is rated as poor because of dams on the creek. Rush Creek below Grant Lake and Walker Creek below Walker Lake are located almost entirely on private land and/or Los Angeles Department of Water and Power lands and are minimally affected by management or plan components in this conservation watershed.

There is little discernable difference between alternatives B and alternative B-modified in regards to water quantity. Alternative B-modified proposes conservation watersheds that provide for large landscape, long-term maintenance of watershed and riparian characteristics to provide for species habitat and water quality compared to critical aquatic refuges, which are generally much smaller in scale. This difference is unlikely to lead to any measurable differences in water quantity between the alternatives.

In addition to the effects discussed in alternative B, this alternative would manage more acres of wildfire for resource benefit and would reduce the potential for high-intensity wildfires. Reducing the risk that high-intensity wildfires would kill vegetation, particularly within riparian areas, would maintain cooler water temperatures by providing more stream shade (Westerling, Hidalgo, Cayan, and Swenam 2006) and reduce accelerated runoff and erosion. Restoration of riparian areas and meadows, combined with upland reintegration of fire into the landscape, would likely foster greater infiltration and recharge shallow groundwater as compared to alternative A. There would likely be a slight, long-term beneficial effect to water quantity in streams and in shallow groundwater.

Climate change is likely to reduce effective precipitation. Overall, shallow groundwater recharge and storage is likely to be slightly reduced under all alternatives due to climate change. Alternative B-modified would help somewhat to maintain shallow groundwater recharge and storage under warming climate conditions as discussed above.

Watershed Conditions

About 89 percent of the watersheds on the Inyo National Forest are in "good/functioning" condition, while the remaining 11 percent are in "fair/at risk" condition. Alternative B-modified proposes four new conservation watersheds, largely located within existing wilderness and inventoried roadless areas, on the Inyo National Forest. The opportunity to focus ecological restoration within the conservation watersheds to benefit watershed health, at-risk species and water quality would be similar to and in some places, slightly increase restoration compared to alternative B for the following reasons:

- Potential Management Approaches places priority on ecological restoration projects and monitoring in conservation watersheds. The intent of the national direction of the Watershed Condition Framework complements plan components for conservation watersheds in that the priority is to protect high-value watersheds already in good condition, maintain the condition of watersheds to keep them from becoming threatened and, improve those in an impaired (at-risk) condition. The focus of the conservation watersheds and national direction for the Watershed Condition Framework is to protect and enhance high value watersheds.
- Active ecological restoration opportunities are limited in designated wilderness. Opportunities are limited to managed activities such as recreation, and managing wildfire for ecological benefit. In addition, limited amounts and types of meadow/stream restoration can occur. About 77 percent of the total acreage of conservation watersheds are located within designated wilderness areas with the remainder, about 23 percent, outside of these areas, which is where the focus of additional active restoration activities would occur. Development of conservation watersheds for the Inyo National Forest (project record) displays Watershed Condition Framework indicator ratings for the four proposed conservation watersheds. There are a total of 14 watersheds with all but one rated as functioning. Standard (MA-CW-STD-01), and guideline (MA-CW-GDL-03) emphasizes the need to design projects to attain functional Watershed Condition Framework indicators.
- Priority watersheds on the Inyo are not located within proposed conservation watersheds. Site-specific work will continue within priority watersheds across all alternatives, including Alternative B and alternative B-modified. In addition, even though critical aquatic refuges are not designated in this alternative, species that occur in these areas have forest-wide direction that provides management for suitable habitat; have specific plan components identified for them or are cover by other regulatory direction.

- The conservation watershed objective (MA-CW-OBJ-01) states:

  > Within 20 years of plan approval, 5 percent of the indicators within the Watershed Condition Framework with a condition rating of 2 or 3 will be improved to a higher rating leading to or trending towards a functional condition rating.

  There are 12 core national indicators in the Watershed Condition Framework. It is recognized that a 5 percent change, which is less than 1, will have minor effects on the overall condition rating of a HUC-12 watersheds contained within the conservation watersheds. If indicators are taken as a whole (see 1 above), out of the 56 indicators rated less than good less than 3 would be required to be moved to a good condition over the course of 20 years. This objective is trying to establish a change to these lower rated indicators, off of which are changed at a finer-scale and may not lead to an overall improvement in the "functioning" condition, but would change the individual indicator.

Conservation watersheds represent a long-term prioritization for maintenance and restoration of watersheds and watershed function. This alternative will maintain and in some cases improve the functional rating of some Watershed Condition Framework indicators including but not limited to fire regime/wildfire, water quality, and aquatic habitat over the long term.

Consequences Specific to Alternative C

Alternative C proposes to reduce high-intensity fire risk by increasing the use of prescribed fire and actively managing wildfire to meet resource objectives. However, because there would be less opportunity to pre-treat fuels in this alternative due to the increase in recommended wilderness areas (325,359 acres compared to 37,029 in alternatives B and B-modified), there is uncertainty in how much area would have wildfires managed to meet resource objectives. This in turn leads to a high degree of uncertainty regarding how alternative C would affect the landscape condition (see "Terrestrial Ecosystems" section). Although alternative C proposes to reduce fuel loading more than alternative A using fire as the primary treatment method, the challenges of actively managing fire without mechanical treatment to lower fuels in the landscape may not result in treating more acres than alternative A. For this analysis, it is assumed that alternative C would result in approximately the same treatment area as alternative A, but treatment would be achieved through different means.

The development of fixed-width riparian conservation areas and associated standards and guidelines in the current forest plans has provided an effective level of protection to water quality throughout the Southern Sierra Nevada. The riparian conservation areas have resulted in reduced soil disturbance and erosion in areas of highest risk of sediment entering a stream.

The current plans also have the critical aquatic refuges as described in the "Aquatic and Riparian Ecosystems" section. Critical aquatic refuges can be areas of focused restoration when needed for species conservation and water quality improvement. The Inyo completed restoration work in several critical aquatic refuges over the past 10 years. Where roads are used for management actions, managers would look for opportunities to maintain, repair, reroute, or improve aquatic organism passages across them through stewardship or partnership opportunities.

Water Quality

Alternative C requires the use of best management practices, standards, and guidelines in project design and implementation that are effective in reducing soil compaction, erosion, and sediment delivery to streams to protect watersheds. Short-term sediment impacts from emphasizing prescribed fire and managed wildfire to achieve restoration goals would be similar to alternative

A. Given the large increase in proposed wilderness, alternative C would reduce ground disturbance from mechanical thinning, but would likely increase the risk of large high-intensity wildfire (see "Terrestrial Ecosystems" section). Prescribed fire under these conditions is likely to burn at greater intensity than other alternatives because of greater fuel loading on the landscape due to less mechanical treatment.

Indirect impacts from high-intensity wildfire are greater than alternatives B and B-modified and similar to alternative A over the long term. High-intensity fires are trending larger and may affect entire or multiple watersheds causing adverse effects to hillslopes, stream channels, infiltration, and runoff. It is these effects that contribute to accelerated soil erosion, impaired water quality, and reduced watershed function (Neary et al 2005).

Alternative C would treat only a small proportion of the lands needing treatment to substantially reduce the risk of high-intensity wildfire. The staff identified lands in need of treatment, including all wildland-urban intermix zones and upland areas of low to moderate slopes. The pace and scale is not sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Since climate change is likely to increase the risk of high-intensity wildfire, the overall water quality and watershed function would decline under alternative C.

Water Quantity

Alternative C would potentially cause reduced flows due to higher evapotranspiration by vegetation over broad landscapes and across watersheds exacerbated by climate change. The decrease of winter snowpack and increased proportion of rain versus snow reduces the infiltration and increases runoff compared to the past. This will potentially cause earlier peak flows, lower late spring and early summer runoff from snowmelt and lower base flows during the dry season. Where high-intensity wildfires occur, evapotranspiration would be greatly reduced for a time, but the runoff increases reflect additional effects from hydrophobic soils. Alternative C would likely reduce annual water yields from surface water.

Shallow groundwater recharge and storage is also potentially reduced due to maintaining a similar pace and scale of terrestrial and meadow restoration as alternative A, exacerbated by climate change effects. Deep percolation through the soils is reduced by evapotranspiration in unburned and untreated areas and infiltration is reduced where high-intensity wildfire has caused hydrophobic soils.

Since alternative C does not limit watershed restoration, the pace and scale may increase as new opportunities and funding sources evolve and partnerships are enhanced to bring such projects to completion. The increase in proposed Wilderness areas could limit the amount of mechanical treatment for meadow and stream restoration compared to other Alternatives. However, where meadow and other aquatic restoration activities would remain at their current pace and scale, shallow groundwater recharge would increase only where the meadows have been restored, but generally decline overall on the forest.

Watershed Conditions

Alternative C emphasizes fuel reduction within the Wildland-urban Intermix Defense Zone and a greater reliance on prescribed fire and managed wildfire to reduce the threat of large high-intensity wildfires compared to alternative A. Alternative C would provide similar direction for protection of riparian conservation areas and would place similar emphasis on watershed restoration as alternative B to maintain or improve watershed conditions. However, overall watershed conditions would continue to be at risk due to large high-intensity wildfire. Alternative

C does not limit watershed restoration and could utilize additional sources of funding and assistance through partnerships to address watershed conditions, though as mentioned above the increase in proposed wilderness would limit the amount of mechanical treatment of degraded meadows and stream channels.

Riparian and aquatic restoration work to help offset impacts of climate change on stream temperatures and availability of water would likely be limited to existing and new priority watersheds and completing essential projects within those watersheds. Riparian areas would not likely change in the short term but would decline over the long term due to the limited pace and scale of ecological restoration of adjacent uplands, except where restoration of riparian structure and native species occurs.

Alternative C requires the use of best management practices and maintains riparian conservation areas like alternative B, but would have less mechanical treatment so the effects are almost all fire related. The emphasis on prescribed fire and managing wildfire to meet resource objectives would result in less soil disturbance and compaction related to equipment use but increased soil impacts from fire. Alternative C would have approximately the same effect on soils as alternative A because the long-term risk of high-intensity wildfire would remain high and the fire intensity of prescribed fire and managed wildfire for resource objectives may be greater than other alternatives. There is more uncertainty in analyzing the potential impact to soil sustainability for alternative C.

Alternative C is not likely to adequately address watershed condition factors such as water quantity, fire regime, forest cover, and some forest health issues such as widespread tree mortality because these require an increase in the pace and scale of terrestrial restoration to achieve equilibrium at a landscape scale, which may be more difficult given the increase in proposed Wilderness acres. Although alternative C addresses the need to emphasize managed fire to maintain and enhance riparian areas, the riparian areas overall may decline due to increased risk of high-intensity wildfire within the riparian conservation areas.

Alternative C proposes additional critical aquatic refuges for the benefit of various aquatic species. These critical aquatic refuges are well distributed throughout the forest both inside and outside wilderness area boundaries. Alternative C presents a wide variety of opportunities to focus restoration to benefit specific aquatic species such as the Yosemite toad and terrestrial species that need moist habitat such as slender salamanders, as well as aquatic biodiversity in critical aquatic refuges across the landscape. Management under alternative C assumes that as restoration work is completed and new priority watersheds would be identified. Since many proposed critical aquatic refuges are within areas to be actively managed, additional opportunities would be available to restore both terrestrial and aquatic habitats within the critical aquatic refuges for the benefit of species and biodiversity.

Consequences Specific to Alternative D

Alternative D proposes to double ecological restoration across the forest compared to alternatives B and B-modified and would address 30 to 60 percent of areas identified as needing this treatment to substantially reduce the risk of high-intensity fire. These treatments are expected to reduce the likelihood of large high-intensity fire compared to current conditions more than the other alternatives (see “Fire Management” and “Air Quality” sections).

The development of fixed width riparian conservation areas and associated standards and guidelines in the current forest plans has provided an effective level of protection to water quality throughout the Southern Sierra Nevada. The riparian conservation areas have resulted in reduced soil disturbance and erosion in areas of highest risk of sediment entering a stream.

The current plans also have the critical aquatic refuges as described in the "Aquatic and Riparian Ecosystems" section. Critical aquatic refuges can be areas of focused restoration when needed for species conservation and water quality improvement. The Inyo completed restoration work in several critical aquatic refuges over the past 10 years. Where roads are used for management actions, managers would look for opportunities to maintain, repair, reroute, or improve aquatic organism passages across them through stewardship or partnership opportunities.

Water Quality

Alternative D would require the use of best management practices, standards, and guidelines in project design and implementation, and would maintain riparian conservation areas similar to alternatives B and B-modified. These would be effective at reducing soil compaction, erosion and sediment delivery to streams to protect watersheds. Short-term sediment impacts from increasing the pace and scale of restoration would likely be higher than the other alternatives because of the increase in treated acres. However, project implementation of best management practices, standards, and guidelines should minimize impacts to water quality.

Alternative D emphasizes restoring ecological integrity to the landscape at an overall pace and scale that would reduce the current upward trend of wildfire frequency and intensity. The long-term potential for indirect impacts of sediment delivery to streams is lower than all other alternatives considered in detail because alternative D would be most effective across more areas at reducing high-intensity wildfire. The emphasis on low- and medium-intensity fires across the landscape (including within the riparian areas) would limit the accumulation of fuels, restore understory plants of cultural importance to Sierra Tribes, and encourage vigorous riparian habitats. The long-term benefits of an increased pace and scale of restoration would be reduced impacts to watersheds, soils, riparian areas, streams, and aquatic habitats from large high-intensity wildfires (Neary et al 2005).

Water quality would be improved in the long term where restoration of watersheds occurs, especially in areas where restoration of meadows and riparian areas provide greater shallow groundwater storage, base flow, and shading of streams. This restoration would be focused in priority watersheds and potentially critical aquatic refuges, as compared to Alternative B-modified, which would focus long-term restoration of conservation watersheds for maintenance of species habitat and water quality. In the short term, the more rapid and larger scale fuels reduction proposed in alternative D could cause some local degradation of water quality; however, project-level protections would minimize increases in sediment due to fuels reduction efforts.

Stream temperature may be improved due to slightly higher base flows caused by lower evapotranspiration on the treated adjacent upland areas. Groundwater recharge of surface water should be greater due to slightly higher infiltration rates across the landscape and restoration of meadows, resulting in higher base flows and lower water temperatures during the dry season.

Water Quantity

Like alternatives B and B-modified, mechanical thinning of trees and low-intensity underburning of vegetation would reduce evapotranspiration and slightly increase or extend the timing of stream flows (Hunsaker and Long 2014). However, alternative D would increase the amount of treated area more than other alternatives considered in detail. Combined with potentially more meadow restorations, alternative D could increase infiltration on a landscape level and encourage more groundwater storage. Encouraging shallow groundwater storage potentially mitigates some of the impacts from climate change by increasing aquatic ecosystem resilience, providing more stable stream flows, and benefitting wildlife dependent on springs.

Climate change is likely to reduce effective precipitation. Deep percolation through the soils is reduced by evapotranspiration in unburned and untreated areas and infiltration is reduced where high-intensity wildfire has caused hydrophobic soils. Overall, alternative D would likely maintain current shallow groundwater recharge and storage under conditions of warming climate better than the other alternatives.

Water quantity may be increased slightly where managers actively restore the watersheds. Since alternative D does not limit watershed restoration, the focus is on priority watersheds and other areas needing active restoration, the pace and scale will increase as new opportunities and funding sources evolve and partnerships are enhanced to bring such projects to completion.

Watershed Conditions

Alternative D would address watershed condition factors such as water quantity, fire regime, forest cover, and some forest health issues through an increased pace and scale of both terrestrial and aquatic restoration.

Like alternative B, alternative D proposes a new critical aquatic refuge for the benefit of the black toad. The opportunity to focus restoration within existing critical aquatic refuges to benefit species is the same as alternative A. The additional critical aquatic refuge in alternative D is outside of areas to be actively managed so impacts would be similar to alternative A except where new opportunities may present themselves to maintain and enhance amphibian habitat.

Models indicate that alternative D is the alternative that best achieves landscape-scale reductions to the risk of high-severity wildfire and provides the greatest resilience to the effects of climate change. Riparian conditions may decline due to increased activity within riparian conservation areas in the short term but they would improve over the long term from the ecological restoration of adjacent uplands and where restoration of riparian structure and native species occurs. The potential for short-term effects from an increased pace and scale of restoration would be balanced against the long-term benefits to riparian areas.

Similar to alternatives B and B-modified, soil conditions may decline slightly in the short term due to ground disturbance by restoration activities but would improve where restoration has reduced the risk of high-intensity wildfire. The critical factors to maintain and enhance soil productivity are to reduce soil disturbance and compaction. The increased pace and scale of ecological restoration, especially using ground-based mechanical equipment, could cause soil disturbance and compaction. The riparian conservation areas and equipment exclusion zones are designed to limit soil disturbance adjacent to streams and to provide filter strips to capture erosion from adjacent uplands. Alternative D maintains similar riparian conservation area protections and requires the use of best management practices similar to alternatives B and B-modified. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to soil sustainability in alternative D.

Alternative D would increase the pace and scale of ecological restoration, to reduce likelihood of large high-intensity fires more than the other alternatives. As a result, alternative D restoration treatments would provide benefits to maintaining water and soil quality and watershed condition over the long term. As forest managers increase the pace and scale of restoration, including mechanical tree thinning and managed fire, the forests should become more resilient to climate change. Alternative D would increase the pace and scale of acres of riparian vegetation improved and meadows restored compared to alternative A. The pace and scale is similar (slightly more acres proposed for treatment) to alternatives B and B-modified with an emphasis on priority watersheds.

Cumulative Effects

The present and foreseeable actions of forest managers and landowners determine cumulative consequences to water quality, water quantity, and watershed condition. The watersheds on the Inyo National Forest are part of the greater southern Sierra Nevada and Great Basin ecosystems and are administered or owned by the Forest Service, the National Park Service, the Bureau of Land Management, the State of California, the Los Angeles Department of Water and Power, Southern California Edison, several Tribes, and thousands of private landowners. The Forest Service manages most of the headwaters of Sierra Nevada rivers, some watersheds in their entirety, and shares management in parts of many watersheds where ownerships overlap.

Successful management of shared and adjacent watersheds requires a concerted effort of the various landowners and a variety of partners. The Forest Service will continue to work with State agencies in the development of total maximum daily load (TMDL) strategic action plans for 303(d)-listed streams. If sources of impairment are identified related to Forest Service management, the action plans may identify mitigation strategies including implementation of best management practices, maintenance or decommissioning of facilities, roads, and trails, implementation of currently planned restoration projects, and removal of existing stressors. The operators of the various dams on these rivers will adapt their operations to meet Federal Energy Regulatory Commission relicensing requirements and to respond to effects of climate change on runoff and baseflows. The Federal Energy Regulatory Commission and the power companies in conjunction with the Forest Service will need to address issues as they arise in the future. Private landowners and the Forest Service will need to work together to achieve stream and meadow restoration where ownership overlaps these areas.

The effectiveness of Forest Service management under all alternatives may be reduced or enhanced by the cumulative efforts of adjacent landowners. For all alternatives, without concerted efforts by many landowners, especially in the foothill and lower montane zones, the potential for long-term adverse cumulative watershed impacts from high-intensity wildfire remains high.

Analytical Conclusions

The alternatives considered in detail outline different approaches to achieving the same overall set of goals for maintaining and enhancing watershed health. This section summarizes how well these alternatives are expected to achieve these goals expressed in terms of the indicators: water quality, water quantity, and watershed condition.

Water Quality

The alternatives vary in how they emphasize water quality impacts over the short term or long term. Alternatives A and C emphasize reduction of impacts over the short term through effective filter strips within the riparian conservation areas and less mechanical treatment, while alternatives B, B-modified and D emphasize a long-term approach through an increased pace and scale of ecological restoration across the landscape. Alternative D best reduces the overall risk of high-intensity wildfire on the Inyo. While short-term impacts of alternatives B, B-modified, and D have a potential for sediment delivery to streams due to the increased amount of treatment, however, these alternatives provide long-term benefits to water quality by reducing the risk of large high-intensity wildfire and resulting sediment more than alternative A or C.

Climate change is causing a risk for higher water temperatures throughout the region and requires restoration of meadows and riparian areas to mitigate this effect. Alternative D provides the greatest opportunity to mitigate the effect of higher air temperatures and subsequent changes in precipitation patterns because it treats the greatest amount of acreage.

Water Quantity

The alternatives differ in approach, pace and scale of ecological restoration and may affect shallow groundwater recharge and storage. Alternatives A and C would likely maintain shallow groundwater at current levels if not for the changing climate tending toward warmer and drier conditions in the Sierra Nevada. Even if precipitation remains the same, more rain and less snow would reduce recharge and storage and increase runoff. Combined with greater evapotranspiration, the precipitation provides less soil moisture for healthy forest vegetation, soil infiltration, and recharging the shallow groundwater. Alternatives B, B-modified, and D would reduce evapotranspiration at a landscape scale and would likely increase the opportunities for infiltration across many watersheds.

Watershed Conditions

The watershed condition framework provides a means to evaluate the alternatives considered in detail in how they would affect watershed conditions. Critical aquatic refuges provide additional protection to watersheds that have high biodiversity of native species or contain sensitive, threatened, or endangered species in alternatives A, B, C and D. Alternative B-modified proposes conservation watersheds instead of critical aquatic refuges and also address maintaining at-risk species habitats and downstream beneficial uses over the long-term. Priority watersheds are carried forward in all the alternatives and provide a means of restoring watershed function in the short-term. Projects developed to maintain and enhance watersheds would continue to move forward in all alternatives, with emphasis of larger-scale watershed restoration under conservation watersheds in alternative B-modified. This restoration work would be balanced with projects in priority watersheds as well. Although the principles behind conservation watersheds are a little different than critical aquatic refuges, conservation watersheds still provide suitable habitat and refugia for at-risk species, both terrestrial and aquatic, that occur within them. Conservation watersheds are areas prioritized for maintenance or restoration activities that have long-term benefits.

As watershed restoration action plans in priority watershed are completed, new priority watersheds will be identified considering restoration needs that are developed and implemented over a 5- to 7-year period. All the alternatives offer additional opportunities for restoration within these priority watersheds through partnerships. Conservation watersheds, in alternative B-modified, represent a long-term prioritization for maintenance and restoration of watersheds particularly focused on aquatic resources. Achievement of desired conditions could take one or more planning cycles and would include additional opportunities through partnerships.

Alternative C creates the greatest number of new critical aquatic refuges, many outside of wilderness boundaries, which could benefit from watershed restoration activities focused on enhancing habitat and improving water quality.

Since the Watershed Condition Framework is composed of various indicators, each alternative was evaluated on how it would likely affect six key indicators (water quality, water quantity, fire regime, forest health, riparian areas, and soils). For fire regime and forest health, alternatives A and C are insufficient to maintain current conditions when they are influenced by climate change combined with insect and disease outbreaks. Alternatives B and B-modified perform better due to the increased pace and scale of ecological restoration and increased acres of wildfire managed for resource benefit and alternative D would show more long-term improvement of these indicators. The soils indicator would likely be maintained by alternatives A and C, but could decline in the short term under alternatives B, B-modified, and D due to the increased amount of mechanical treatments as described in the Consequences section above.

Plan components and potential management approaches for the conservation watersheds specifically address attaining functional Watershed Condition Framework indicators within several planning cycles, which differs from alternatives A, B, C, and D.

A key driver for improving watershed condition across the Inyo National Forest is restoration of the fire regime and forest health indicators, because long-term water quality and quantity are closely linked to these ecosystem conditions. Alternatives A and C would take longer than alternatives B, B-modified, or D to restore fire regime and forest health at a landscape level. Alternative D would be most likely to maintain watersheds at properly functioning or improve the condition of the greatest number of watersheds. Alternative D would also create the greatest number of watersheds on the Inyo that would be resilient to the impacts of climate change.

Aquatic and Riparian Ecosystem Integrity

Background

This section summarizes the current conditions in aquatic and riparian ecosystems on the Inyo National Forest, and the consequences of adopting the revised plan or its alternatives. Much of the analysis is based upon the premise that the natural range of variation provides important background for evaluating ecological integrity and sustainability (Wiens et al. 2012). It was used to develop plan direction and select indicators and measures for the analysis. Also important in the analysis of ecological integrity and sustainability of riparian and aquatic ecosystems was consideration of climate and associated ecological and watershed level conditions that are outside the natural range of variation. Natural range of variation is a concept that focuses on the dynamic nature of ecosystems, recognizing they are not static (Landres, Morgan, and Swanson 1999b). It recognizes that disturbances, such as drought, floods, or fire, are natural processes. Legacy land uses and the uncertain future due to a variable climate were also incorporated into the analyses. To address aquatic and riparian ecosystem integrity, the proposed plan includes desired conditions designed to:

- provide resilience to climate change;
- restore or maintain the function of streams, meadows, riparian areas, seeps, and springs;
- avoid invasive species;
- conserve biodiversity;

- preserve and reestablish ecological connectivity; and
- promote resilience to fire in riparian ecosystems.

The extent the alternatives would move toward the proposed desired conditions is analyzed in this section. The riparian and aquatic ecosystems are interconnected with watershed conditions, water quality, and water quantity. Watershed condition and function are further discussed recognizing these connections in the "Water Quality, Water Quantity, and Watershed Condition" section.

Ecological integrity is a measure of an aquatic and riparian ecosystem's functional and structural conditions. Functional conditions include the surface water flow that sustains aquatic and riparian habitats; shallow groundwater recharge; water temperatures; carbon and nitrogen sequestration; and nutrient cycling. Structural conditions include habitat type and availability, migration corridors among habitats, and structure and composition of riparian vegetation. These ecosystem conditions affect suitability of habitat, biodiversity, connectivity and resilience to climate change. Aquatic and riparian ecosystem conditions in the southern Sierra Nevada vary depending on the amount of past and current land disturbance that has and is occurring within the area, and the effect of climate changes on the natural integrity of the ecosystems. The severity of effects is influenced in part by the elevation, fire regime, precipitation, and management of these areas.

Analysis and Methods

This qualitative analysis is based primarily on the best available scientific information derived from the Inyo forest assessment (USDA Forest Service 2013a), the Bio-Regional Assessment (USDA Forest Service 2013d), the Science Synthesis (Long et al. 2014), recent reports and publications that assess trends in current conditions (Isaak 2015), and where available, assessment of effects of management actions. Aquatic habitats and diversity, groundwater-dependent systems, and riparian ecosystem functions that were assessed at a broad scale are evaluated. Key ecosystem characteristics are used to predict whether future conditions will provide for ecological integrity under the different alternatives. Only key ecosystem characteristics that could be influenced by management following plan direction or by climate change were selected. For this analysis, these indicator measures were assessed at the landscape level or across the southern Sierra Nevada and great basin ecosystems of the White Mountain and Inyo Mountain ranges.

Indicators and Measures

Sustainability of aquatic habitat (including presence of invasive species), ecological connectivity, biodiversity (includes plant and animals), resilience to climate change, and riparian vegetation were selected indicators because they could be assessed across the landscape, were indicators of the desired conditions, and were important measures of aquatic and riparian ecosystem integrity. All aquatic ecosystems including fens, wet meadows, seeps, springs, stream, lakes, ponds and rivers are referred to as aquatic ecosystems in the analysis. Aquatic indicators cover all the various aquatic and semi-aquatic habitats.

Sustainability of Habitat

- Management to maintain or improve habitat for all life stages of aquatic and riparian species.
- Management direction to reduce invasive aquatic species.

Ecological Connectivity

- Management to reduce or improve road crossings and small dams and diversions affecting aquatic at-risk species.

- Management of connectivity among habitats for aquatic or riparian associates.

Biodiversity

- Management that improves biodiversity of riparian and aquatic associates to including both plant and animal (terrestrial and aquatic), at-risk species, rare and common native species and nonnative desirable species (e.g. tule elk, chukar, brown, rainbow, or brook trout).

Resilience to Climate Change

- Rate of restoration to improve resilience to climate change, including the change in timing and availability of water from snowmelt, of priority habitats for all life stages of aquatic or riparian associates, including at-risk species.

Riparian Vegetation

- Management of riparian conservation areas to promote native species including understory vegetation, as indicated by management direction.
- Rate of ecological restoration to reduce risk of high-intensity wildfire and promote native shrub diversity in riparian areas.
- Rate of restoration of riparian areas to promote native species, reduce the risk of high-intensity wildfire, and promote wildfires managed to meet resource objectives.

The environmental consequences section provides a qualitative assessment of forecasted trends in indicator measures by alternative based on the effects from potential watershed restoration activities; meeting objectives for meadow, stream, aquatic organism passage, and riparian area restoration; forest vegetation restoration activities; recreation activities; trails and road crossings management; invasive species management, and climate change management on these indicator measures.

Assumptions

There are several key assumptions about why, when, where, and how restoration treatments would occur in aquatic and riparian areas that were used in the analysis.

- Functioning watersheds deliver the highest quality water.
- Target restoration in conservation watersheds where the greatest ecological gains can be made with the least amount of funding.
- The headwaters for most streams and lakes are located in remote, high elevation wilderness areas, ensuring that impacts to water quality are minimal.
- Restoration of aquatic organism passage would be examined to determine effects on aquatic and riparian at-risk species from projects, such as culverts, beaver dams, and creek crossing, so that desired barriers are maintained to prevent invasive fish and organisms from entering habitats that might impact at-risk species.
- National forest managers would use an integrated restoration approach to designing projects that strive to balance watershed restoration with terrestrial restoration. Partnerships may provide increased funding and capacity for restoration treatments of all types, and build opportunities to restore aquatic habitats on the Inyo National Forest and adjacent lands using an “all lands approach.”
- Within riparian areas, vegetation treatments would occur to move vegetation toward the desired conditions. This would be primarily to restore native species composition and reduce the encroachment of conifer trees, salt cedar, sagebrush, etc., where appropriate. The

end result of the treatments would generally be more diversity of riparian hardwood species and sizes, as well as vigorously growing herbaceous vegetation.

- Most riparian vegetation restoration would occur in areas where the adjacent upland areas are being restored.
- Aquatic habitat restoration in streams, meadows, and other special aquatic habitats would be primarily to improve habitats for at-risk species and to improve downstream beneficial uses. Aquatic habitat restoration would be integrated into landscape treatment designs where appropriate. Partnerships and additional funding opportunities from sources outside the Forest Service would be sought to increase the pace and scale of aquatic habitat restoration.

Table 48 outlines the objectives for the number of acres of riparian vegetation improved; number of meadows enhanced or improved; and miles of streams restored for each of the plan revision alternatives. These numbers are the basis for the aquatic and riparian ecosystem effects analysis.

Table 48. Water, aquatic and riparian restoration activities by alternative per decade

Type of Restoration	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Acres of riparian vegetation improved (MA-RCA-OBJ-01)	300-400	400-500	At least 400	400-500	500-600
Number of meadows enhanced or improved (RCA-MEAD-OBJ-01)	3-5	5-10	At least 5	20-25	5-10
Miles of streams restored (RCA-RIV-OBJ-01)	10-20	10-20	At least 10	20 - 30	10 - 20

Affected Environment

Aquatic habitat integrity within the Inyo National Forest is generally better in the higher elevation portions of the analysis area and within existing protected areas due to fewer alterations (water diversions) than lower elevation areas. There are some aspects of aquatic habitat integrity that are outside the natural range of variation within the forest including species assemblages and flow regimes altered by fish stocking, diversions, and dams.

The Inyo uses the Watershed Condition Framework data to evaluate the condition class of watersheds (HUC 12 size class) and 89 percent are functioning properly. Out of 132 watersheds (HUC 12 size class) in the plan area, 118 are functioning properly, 14 are considered functioning at risk while zero are rated as impaired (see table 47 on page 267). These are based on several criteria ratings from vegetation condition, water quality and quantity, soil, cover, invasive and rangeland condition to name a few (see “Water Quality, Water Quantity, and Watershed Condition” section). These data are baseline indicators and provide valuable information for both managing for resources and recreation as well as to downstream users who rely on these high beneficial uses for municipal uses, agriculture, and economic value.

The current plan has critical aquatic refuges, which are brought forward (alternative A) and expanded in alternatives B, C, and D and are designed to preserve, enhance, restore or connect habitats for aquatic species at the local level and to ensure the persistence of aquatic species. Table 49 summarizes critical aquatic refuges by alternative and the overall watershed condition rating in the watersheds.

Table 49. Summary of critical aquatic refuges (conservation watersheds in alternative B-Modified) and watershed conditions on the Inyo National Forest

Alternative	Number of Critical Aquatic Refuges*	Watersheds in Good Condition (Functioning Properly)	Watersheds in Fair Condition (Functioning At Risk)	Watersheds in Poor Condition (Impaired Function)
A	17	15	2	0
B	18	16	2	0
C	25	22	3	0
D	18	16	2	0

* Types of species provided are amphibians, fish, and aquatic snails

Alternative A has 17 critical aquatic refuges totaling 170,600 acres (table 50).

Alternative B and D would both have the same 18 critical aquatic refuges totaling 191,567 acres.

Alternative C would have 25 designated critical aquatic refuges totaling 322,500 acres.

Critical aquatic refuges provide additional protection to watersheds that contain Regional Forester sensitive species, or federally listed threatened or endangered species. Critical aquatic refuges were developed as a management area within the 2001 Sierra Nevada Forest Plan Amendment and retained in the 2004 Supplemental Sierra Nevada Forest Plan Amendment. Critical aquatic refuges (CARs) had been defined:

> to preserve, enhance, restore or connect habitats distributed across the landscape for sensitive or listed species to contribute to their viability and recovery. In many cases, CARs supported the best remaining populations of native fish, amphibian, and plant species with substantially reduced distributions elsewhere in the Sierra Nevada. CARs are managed as RCAs [riparian conservation areas]; standards and guidelines that apply to RCAs also apply in CARs. Existing activities that are determined to be inconsistent with riparian conservation objectives (RCO) may be mitigated or removed to ensure consistency with RCOs. New projects and activities will be consistent with RCOs. New activities, such as development of dams or diversions or mineral extraction, are generally not appropriate within CARs. CARs also have high priority for watershed restoration activities. CARs will be evaluated and proposed for withdrawal from mineral entry, as appropriate. (USDA FS 2004 – ROD, appendix B).

The Inyo National Forest has critical aquatic refuges of various sizes associated with a particular species. Many critical aquatic refuges are encompassed within areas of high aquatic integrity and inventoried roadless areas or wilderness, particularly those delineated for Lahontan and Paiute cutthroat trout, California golden trout, Yosemite toad, and yellow-legged frogs.

Alternative B-modified brings forward four conservation watersheds in place of critical aquatic refuges. The development of conservation watersheds are explained fully in "Consequences Specific to Alternative B-modified."

Implementation of the current Inyo National Forest grazing management strategy (USDA Forest Service 1995a) is expected to improve, or continue to improve vegetation and watershed condition trends, for the next 20 years, particularly within riparian conservation areas. There are 50 livestock allotments administered by the Inyo National Forest. Thirty-six of the allotments are active, 11 are vacant and 3 are closed. Closed allotments are those where livestock grazing has been found to be incompatible with the desired conditions or result in substantial and permanent impairment of the land. Approximately 1,216,142 acres or 59 percent of National Forest System lands administered by the Inyo National Forest are considered not suitable for livestock grazing and production.

Across the Sierra Nevada, aquatic biodiversity is vulnerable, as indicated by declining trends in native fish, amphibians, and other species (Moyle and Randall 1998; Moyle, Katz, and Quiñones 2011; Baumsteiger and Moyle 2017; Purdy, Moyle, and Tate 2012; Viers and Rheinheimer 2011; Viers et al. 2013; Vredenburg et al. 2007; Frissell, Scurlock, and Kattelmann 2012). Depending on the species groups, 40 to 80 percent of all aquatic species in California are now facing extinction, unless current trends are reversed by active management and conservation (Frissell, Scurlock, and Kattelmann 2012; Howard et al. 2015; Katz et al. 2013; Quiñones and Moyle 2015). In 2010, the primary threats to aquatic biodiversity were ranked as follows: invasive alien species were considered the most detrimental threat (34 percent), followed by major dams and associated water diversions (24 percent), agriculture (18 percent), hatcheries (14 percent), and estuarine alteration (12 percent) (Moyle, Katz, and Quiñones 2011). Specific to the plan area, the primary threats to aquatic biodiversity are historic fish stocking practices of nonnative fish that pose a threat from hybridization to native trout species, and the prevalence of diseases from chytrid fungus (*Bd*) infestations that results in mass die offs of native amphibian species.

Aquatic and riparian ecosystems are also experiencing illegal marijuana cultivation on public lands that can have alarming effects on soil, water, and wildlife. Eradication and remediation of illegal marijuana growing operations turn up miles of irrigation piping used to divert water to support growing marijuana plants. Fertilizers, pesticides and poisons are used in the propagation and protections of such grow sites. Routinely detected is one of the most toxic carbamate pesticide ever produced, Carbofuran, which is used both to reduce insect damage to marijuana plants and poison mammals. As such, it is banned by the Environmental Protection Agency and California Department of Pesticides and Regulations (since 2009); it is also banned in Canada and the European Union because it is a human and safety risk. Invertebrates can accumulate rodenticide compounds in their tissue without negative effects and move beyond the grow site, thereby facilitating secondary poisoning (Gabriel et al. 2012). Therefore, contamination of watercourses from runoff, or direct placement of rodenticides at these sites, could expose aquatic biota and terrestrial species that are dependent on these water sources to these toxicants (Primus, Wright, and Fisher 2005, Rueda et al. 2016).

Illegal marijuana eradication and remediation has occurred on the Inyo using water sources from perennial systems. These grow sites have led to poisoning of native species, but it is unknown if this lead to effects to aquatic species. Aquatic habitats were impacted by these sites due to water diversions from piping out of natural water sources.

Rivers and Streams

The Owens, South Fork of the Kern, and Middle Fork of the San Joaquin Rivers originate on the Inyo National Forest and contain headwaters of water systems in the eastern Sierra Nevada, White, Inyo and Glass Mountain ranges. The Owens River drains the east side of the Sierra Nevada and the west side of the White Mountains. Because the eastern slope is in a rain shadow and drier, permanent streams, meadows and springs are especially important for wildlife and fisheries. The upper Owens River and smaller permanent streams historically flowed into Owens Lake but much of the flow is now diverted to Los Angeles for beneficial uses, such as domestic consumption or irrigation.

The South Fork Kern River flows north to south through the Kern Plateau, which is shared by the Inyo and Sequoia National Forests. The Kern Plateau is home to many springs and meadows that maintain perennial streams. Angling opportunities on the Forest also include the chance to catch California golden trout in their native habitat of the South Fork Kern River and Golden Trout

Creek. The San Joaquin River drains a small part of the west side of the Inyo National Forest in its upper reaches and flows west through the Sierra National Forest.

Springs and perennial streams flow off the east side of the White and Inyo Mountain range providing water to Nevada, Death Valley, and lands administered by the Bureau of Land Management. Currently, Cottonwood Creek and Cabin Creek have established refuges that provide for populations of Paiute cutthroat trout that originated through stocking means. Cabin Creek is managed as a blue ribbon angler's location while North Fork Cottonwood Creek is managed for restocking and augmenting of natal sites experiencing population declines. In 2017, a coordinated effort between agencies successfully transported 87 individuals with use of Forest Service pack stock to augment the Silver King Creek above Llewellyn Falls in the Carson Iceberg Wilderness area of the Humboldt-Toiyabe National Forest.

Watershed condition ratings for stream reaches within grazed allotments at 67 reaches (59 percent) are properly functioning, 42 reaches (37 percent) are functioning at risk (with different trend ratings), and five reaches (5 percent) are non-functioning. The clear, cold waters that flow through the Inyo National Forest are prime habitat for cold water salmonid fish, which have been introduced in to these waters to provide quality fishing experiences. The Inyo offers suitable habitat for nonnative trout species (rainbow, brook, and brown trout) and golden trout. Although the Inyo is often thought to be dry, there is an estimated 1,640 miles of perennial streams, the majority of which offer angling opportunities. Common native species found in these systems include a variety of stream-dwelling macro-invertebrates, such as mollusk, caddis flies, mayflies, and stone flies. Seventy-eight percent of streams were found to be in good condition on national forest lands in the southern Sierra Nevada based on assessment of macro-invertebrate populations (Furnish 2013).

Within the last 100 years, native mountain yellow-legged frogs in the Sierra Nevada mountain range have gone from most abundant frog to the rarest due to fish stocking practices and the arrival of chytrid fungus (*Bd*) in Kings Canyon National Park (1960-70) that resulted in complete extirpation of some frog populations (Knapp 2017). Brown trout and rainbow trout were introduced into eastside Sierra streams and lakes as they are prized by anglers, but they prey on native amphibian populations. The California Department of Fish and Wildlife manages the fishery resources in the state and has changed fish stocking policies using triploid fish that are unable to reproduce, and work to remove stocked species from streams and lakes to in effort to restore native species where possible (Frissell, Scurlock, and Kattelmann 2012). The Forest Service works closely with California Department of Fish and Wildlife to return native species to the landscape in balance with managing for recreational fishing opportunities.

Aquatic nonnative, invasive vertebrate and invertebrate, and pathogen species are present within the plan area and can be attributed to reduced angling opportunities, mass frog die offs, and increased maintenance concern of hydroelectric and hydropower infrastructure. Fish stocking is known to be detrimental to native species, especially amphibians (Schwartz, Thorne, and Holguin 2013). The New Zealand mud snail is established in the Owens River watershed and has been found to cause disruptions in stream food chains throughout the western states (Moore et al. 2012).Aquatic invasive species will likely continue to spread throughout streams, rivers and reservoirs on boats, fishing equipment, and other water sports gear (CDFW 2008). Nonnative and invasive species are a continual and pervasive threat to native species in lakes and streams as it can be difficult and expensive to control them once they become established. The Inyo National Forest continues to manage *Bd* persistent frog populations (e.g., Mulkey Meadow) and *Bd* negative aquatic habitats in partnership with California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service. Plans are in place to respond to mass frog die offs that include *Bd* inoculation efforts and rearing tadpoles to frogs in efforts to reintroduce disease free individuals back into *Bd* affected environments.

Dams and water impoundments block movements of fish, amphibians, and aquatic insects resulting in a lack of habitat connectivity. However, the eastern Sierra streams have natural barriers and no native trout species move throughout the water systems similar to those of the west side of the mountain range. The only example in the plan area where dams create large barriers is on the San Joaquin. Its tributaries block salmon from reaching former habitat on the adjacent Sierra National Forest. By contrast, where at-risk fish or amphibian species are present it is often desirable to maintain barriers to aquatic connectivity to keep nonnative fish out of these waters. Examples of species managed beyond natural (or manmade) barriers, include golden trout, Lahontan cutthroat trout, and Paiute cutthroat trout.

Meadows, Fens, and Springs

Meadows

The Inyo National Forest has more than 25,000 acres of meadows. Although the overall area of meadows is a small proportion of the landscape (around 2 percent of national forest lands higher than 6,000 feet elevation), they provide critical ecosystem function. The Kern Plateau on the Inyo and Sequoia National Forest is an exception to this general pattern where meadows occupy an estimated 10 percent of the landscape. In general, wet meadows tend to have lower amounts of bare soil compared to dry meadows that have a wider spacing of vegetation and more exposed soil. Dry meadows occur in the most arid topographic positions and are primarily precipitation-dependent.

There are 1,479 meadows on the Inyo National Forest, of which 384 are in active grazing allotments and 202 in vacant grazing allotments (Roche et al. 2015). Meadows occupy between 26,000 and 50,000 acres on National Forest System lands, depending on the definition and the scale of mapping. When dry alpine or subalpine meadows are included, the area is increased. The landscape of meadows extent depends on location. There have been no systematic condition assessments of all the meadows on the Inyo National Forest. Researchers sampled 10 randomly selected meadows on the Inyo National Forest, as part of a Sierra Nevada study (Fryjoff-Hung and Viers. 2013). Otherwise, assessments have focused on key grazing area meadows within active grazing allotments and packstock use areas. Rangeland conditions for these are described below. The condition rating of key grazing areas may not represent overall condition of special aquatic features across the national forest (USDA Forest Service 2013a).

Meadow condition depends on vegetation, hydrology, stream channel condition, and invasive species (Purdy, Moyle, and Tate 2012). Viers et al. (2013) found during drought in the Sierra Nevada that vegetation cover and bare ground cover ranged from natural condition to moderately or heavily impacted, depending on the montane meadow location. Meadows with incised channels are less resilient to water flow changes over time and face increased risk of damage from wildfire. Where meadow conditions are degraded, restoration may be necessary to restore hydrologic functions for dependent vegetation such as perennials, annuals, and willows (Frissell, Scurlock, and Kattelmann 2012).

In 1999, the Forest Service Pacific Southwest Region Range Program initiated a regionwide, long-term meadow condition and trend monitoring program. The primary purpose of the program was to (1) document baseline meadow conditions as these new riparian standards and guidelines were coming into use, and (2) examine long-term trends in meadow condition following implementation of these riparian standard and guidelines. The program currently includes 618 permanent meadow vegetation monitoring sites established in key meadows across the region including the Inyo National Forest. Vegetation composition is measured at the time a plot is established and then every 5 years following. There are 496 plots within the 10 national forests covered under the Sierra Nevada Forest Amendment. As of summer 2012, a total of 246 plots had been reevaluated over the past 10 years, across 127 grazing allotments.

Specific to the Inyo National Forest, Freitas et al. (2014) examined the same Forest Service data set for 25 monitoring sites on the Kern Plateau within two vacant allotments and two active allotments. Freitas et al. concluded that riparian conservation grazing strategies implemented on the active allotments neither degraded nor hampered recovery of meadow conditions relative to non-grazed meadow conditions in the vacant allotments.

Meadows and Rangelands: In 2012, the Forest Service Pacific Southwest Region and the University of California, Davis Rangeland Watershed Laboratory established a partnership to conduct the first comprehensive analysis of this unique dataset examining, meadow conditions and trends and the relationships between meadow conditions and trends, livestock management, weather, and environmental drivers (Roche et al. 2015). In this analysis, the number of plots available with at least 8 years between their earliest measurement (1997 to 2002) and the latest measurement (2007 to 2012) was 42 on the Inyo National Forest. The meadow plant community condition metrics analyzed included relative frequency data, Ratliff Vegetation Score and Condition Classification, and species richness and diversity. The comprehensive analysis found a significant increase in mean species richness and species diversity. There was no significant change in Ratliff condition class between the readings.

Five percent of these rangeland plots on the Inyo National Forest showed excellent to good vegetation condition with an upward trend: 74 percent were in excellent to good vegetation condition with a stable trend; 14 percent were in good vegetation condition with a downward trend; no plots were in a fair vegetation condition with an upward trend; 2 percent were in fair vegetation condition with a stable trend; 5 percent were in fair vegetation condition with a downward trend; and no plots were in poor vegetation condition (USDA FS 2013a).

Because no systematic assessment of meadows exist in the Southern Sierra Nevada, the forest assessments provide information about a subset of meadows overall. Other meadow and stream assessments covering the Kern Plateau, and other areas on adjacent forests, indicated that a majority of meadows exhibited features such as ingrowth of trees, unstable banks, off-highway vehicle trails, headcuts, and gullies (Fryjoff-Hung and Viers. 2013)

Another study on the Inyo National Forest, which included the Kern Plateau, found that meadow plant species richness, diversity, evenness, and frequency of soil-substrate stabilizing species were not significantly different between grazed and ungrazed sites (Freitas et al. 2013). Modest increases in richness and diversity were observed over the 10-year study period, while evenness and frequency of soil-substrate stabilizing species were constant.

Fens

Fens are special sensitive habitat types with deep organic soils found at high elevation on the Inyo (Wolf and Cooper 2015, Kattelmann and Embury 1996). Peatlands are at the wettest end of this hydrologic spectrum, occurring primarily as fens in the plan area. While the exact number of fens on the Inyo National Forest is not known (and no consistent assessment exists), fens are estimated to represent about 10 percent of the meadows on the adjacent Sequoia National Forest and about 1 percent of the landscape (M. Linton, personal communication). Further north, fens in Sequoia and Kings Canyon National Parks cover approximately 0.2 percent of the landscape (Hopkinson et al. 2013). On the Inyo National Forest, proper functioning condition information for fens that have been evaluated indicate that most either are properly functioning, or have an upward trend, or no trend (USDA Forest Service 2013a).

There are a total of 235 known fens on the Inyo National Forest. Generally, these fens are found within the larger meadow complexes. A total of 129 fens are within grazing allotments; 59 in active allotments and 70 in vacant allotments (University of California 2017, USDA Forest Service 2017d). Within these meadow complexes, fens play an important role in nutrient cycling and groundwater discharge, provide habitat for rare species, and are a major sink for atmospheric carbon (Weixelman and Cooper 2009). Proper functioning condition information for fens indicated that most either were properly functioning, or had an upward trend, or no trend. A small proportion was found to have a downward trend.

Springs and Seeps

Springs and seeps are a result of both precipitation and geologic structure and are generally found throughout the plan area. From the highest passes and valleys into the lower elevations, springs are found throughout the southern Sierra Nevada and the White and Inyo Mountains. Fully functioning springs are typically considered “biodiversity hotspots” supporting many species that only occur there, most notably spring snails. Spring habitats are vulnerable to damage from on- or off-site changes of water or land uses and species associated with springs typically have limited mobility; therefore, effective protection of springs is necessary to protect endemic species (Frissell et al. 2012). There is little information about the current trends for springs across the landscape. However, drought has influenced flow in many springs, so the uncertainty of climate change may influence this habitat.

Lakes

Lakes on the eastern side of the Sierra Nevada Mountains in the Inyo National Forest range in size from 1 acre to hundreds of acres. No lakes occur in the White, Inyo, or Glass Mountains. Mono Lake is a vast inland saline lake of 44,480 acres. Approximately 478 freshwater lakes that are larger than 2 acres occur on the Inyo National Forest (USDA Forest Service 2013a). Ponds and other small waterbodies, such as tarns and pools, occur throughout the higher elevations within the Sierra Nevada Mountains.

Historically, the lakes of the high Sierra Nevada were fishless and supported native fauna such as amphibians, aquatic insects, abundant zooplankton, and phytoplankton. However, many of the high-elevation lakes now support introduced brook, brown, rainbow and golden trout, which has had an impact on native frog populations (Knapp, Boiano, and Vredenburg 2007; Knapp and Matthews 2000a and 2000b). The historic introduction of trout into lakes throughout the Sierra Nevada mountain range has had the effect of eliminating the yellow-legged frog from over 95 percent of its historic range (Vredenburg et al. 2007). The introduction of trout into these lakes has also altered the life-cycle and reduced the population numbers of macro-invertebrates and zooplankton within lakes (Knapp 2005; Schindler, Knapp, and Leavitt 2001). The loss of these keystone species changes the food web, and changes biodiversity. Aquatic ecosystem biodiversity in many of these lakes is outside the natural range of variation. A few lakes have remained fishless, or have had fish removed to protect amphibians and are being protected from additional fish stocking by changes in stocking rules by the State fish and wildlife agencies. These fishless lakes provide important refuges for some amphibians to support their persistence. The stocking program allows for the persistence of trout species to occur throughout the plan area and provides the availability of angling in these areas. Fishing is an important economic benefit to the local communities and lake systems make up a high use of visiting anglers during open fishing season. The California Department of Fish and Wildlife determines the schedule for stocking lakes and streams within and adjacent to the Inyo National Forest. Angler surveys and creel samples help determine where to stock hatchery resources.

Riparian Ecosystems

Riparian vegetation composition and structure are influenced by the size and type of stream, the amount of flooding, and the surrounding upland ecosystems and vegetation (Kondolf et al. 1996) Kattelmann and Embury 1996). The diversity is also reflected by three major biological provinces: Sierra Nevada Mountains, Great Basin Desert, and Mohave Desert. In the Eastern Sierra Nevada region, the elevation gradient is abrupt, creating rapid transitions from desert and sagebrush vegetation at the lowest elevations, to pinyon-juniper woodlands, coniferous forests, and alpine areas. At lower elevations on the east slope of the Sierra Nevada, often only a few trees such as cottonwoods, willows, and birch are found. These systems are naturally drier and the riparian areas are limited in width. Similarly, at higher elevations throughout the Inyo National Forest, riparian vegetation is more limited in width in the subalpine and alpine areas with narrow bands of herbaceous riparian plants and often deciduous shrubs (such as creek dogwood or willow) are interspersed with upland forest trees (mostly conifers) growing next to the streams. Riparian plants can include grasses, sedges, shrubs, and trees (birch, aspen, cottonwood and black oak). Along larger streams, willow shrubs are common and plant communities vary by elevation and aspect. The White and Inyo Mountains region is situated in the rain shadow of the Sierra Nevada, and receives less precipitation, as evident in the arid-adapted vegetation. Here too riparian areas are also naturally drier and limited in width. Several riparian areas are supported by springs and seeps in remote areas and several creeks experience year round flows that support meadow systems that include grasses, sedges, and shrubs. Willows are not as common among the riparian here, introduction of willow occurred along the north fork of Cottonwood Creek to provide refugia for reaches where Paiute cutthroat trout are managed. Aspen grooves occur within the White Mountain and Sierra range and are associated with springs, creeks, uplands, and snow pockets.

In the absence of fire within the natural range of variation, conifers have grown into riparian areas and often are taller and now shade riparian hardwood trees, shrubs, and herbaceous plants in many areas of the east slope of the Sierra Nevada. Encroachment in aspen stands increases the fuel loads. This has occurred especially at low and middle elevations where fire was historically more frequent and trees grow relatively fast. Many riparian areas have become more uniform with dense overstory cover (especially of conifers), and fewer vigorous and diverse understory deciduous shrubs, grasses, sedges, and herbaceous plants. Many riparian plant species are adapted to disturbances such as floods, and vigorously resprout after disturbance. This makes them resilient to fire as well (Pettit and Naiman 2007). When composition and structure of riparian vegetation becomes dominated by conifers, especially at a high density, it becomes less resilient to fire. Many of the riparian areas in the analysis area are in this condition of low resilience. Fire return intervals are not within the natural range of variation over much of the landscape, and thus not within the range of variation for the interspersed riparian areas. 2015). A key aspect of understory composition that is affected by vegetation conditions and management is presence, condition and abundance of native sun-loving and fire enhanced plants. These two groups of plants have presumably had the greatest departure from the natural range of variability (Stevens and Safford in press). If implementation of the current Inyo National Forest grazing management strategy (USDA Forest Service 1995a) were to continue, vegetation and watershed condition trends are expected to improve, or continue to improve, for the next 20 years, particularly within riparian conservation areas.

Climate Change Influences to Aquatic and Riparian Ecosystems

The climate in the southern Sierra Nevada and White and Glass Mountains is normally variable by season and from year to year, and highly dependent on elevation, slope and aspect. Average annual precipitation ranges from 9 to 20 inches at lower elevations along the southern end of the Sierra Nevada, Kern River, and eastern slope; and up to 49 to 59 inches at higher elevations (Wolf and Cooper 2015, Kattelmann and Embury 1996). The White Mountains are generally drier than the Sierra Nevada and precipitation ranges from 6 inches in the lower valleys to 20 inches on the crest of the range (Powell and Klieforth 1991). Changes in climate have influenced the quantity, quality, or seasonality of water and can have significant impacts on the ecological integrity of aquatic systems. Warming temperatures, particularly when combined with less precipitation, results in loss of stream flows, drying of shallow lakes or ponds, and changes in seasonal availability of aquatic habitat. Resilience of streams to climate change is influenced by sources of water, riparian forest cover, and meadow area (Frissell et al. 2012).

Changes in timing of snowmelt are already influencing stream flow patterns (Hunsaker, Long, and Herbst 2014b). Flood potential is predicted to increase, as is the proportion of precipitation falling as rain instead of snow (Safford, North, and Meyer 2012). This is likely to continue (Null et al. 2010) and will impact aquatic ecosystems through seasonal changes, decreased water flows and increased water temperatures. Stream flows in summer are declining and floods are occurring in winter rather than spring in areas dominated by snowmelt (Luce and Holden 2009, Isaak and Rieman 2013). These changes along with increases in stream temperature are expected to shift distributions of native fishes according to their water temperature requirement (Isaak et al. 2012; Rieman et al. 2007; Wenger, Isaak, Dunham et al. 2011; Wenger, Isaak, Luce et al. 2011).

Over the next century, climate change is predicted to alter hydrologic and precipitation patterns, riparian vegetation, and the role of fire in riparian areas. This will have important effects on aquatic and riparian ecosystems, since they are shaped and are dependent on the amount and pattern of water.

Climate change has the potential to affect surface and groundwater flows. If there are more severe floods that follow severe droughts, erosion of stream channels could increase. The rain-snow interface zone is predicted to occur at higher elevations, causing warming of streams earlier in the season. Streambank vegetation could decrease in vigor and extent if summer base flows become much lower or some perennial streams become intermittent. Then, when high flows occur, there would be a greater chance of channel scour and possible widening or gully incision.

Environmental Consequences to Aquatic and Riparian Ecosystems

Consequences Common to all Alternatives

Sustainability of Habitat

All alternatives provide basic protection of aquatic habitat from sedimentation, erosion, and nutrient mobilization; impediments to connectivity; and undesirable vegetation conditions is essential to ensure the resilience of aquatic habitats in the face of climate change, drought, and fire. Aquatic and riparian areas are a focus under all alternatives, and all alternatives incorporate riparian conservation area direction to ensure the Inyo staff considers effects to aquatic and riparian habitat in all project decisions. Plan components in all alternatives address treatment of existing headcuts in meadows and streams; impaired hydrologic connectivity and ecological connectivity; lack of mature willows, alders, and cottonwoods; sediment impacts from roads; legacy grazing impacts; and impacts from recreation use [are all identified as areas in need of restoration. All alternatives would also continue to implement work in priority watersheds as defined by the Watershed Condition Framework, for short-term restoration focus. While these project-level decisions and site-specific restoration actions could be similar under all alternatives, the broader-scale view of watershed restoration and landscape-level management focus should help create greater resilience to climate change and stochastic effects on a watershed and forestwide scale, as discussed by alternative below.

All alternatives require the use of best management practices in project design and implementation. Implementation of range best management practices are effective in reducing soil erosion and sediment delivery to streams, and annual monitoring of best management practices implementation and effectiveness will continue to help the Inyo modify practices to further reduce adverse impacts to riparian habitat. The aquatic and riparian plan components include forestwide watershed and riparian conservation area direction for the desired ecological conditions, and objectives outline a reasonable rate of progress given resources available. Monitoring and re-assessing indicators and attributes to assess watershed functioning condition facilitates adaptive management. Continuing to implement restoration projects within priority watersheds also contributes to achieving desired conditions. A watershed restoration action plan is developed for all priority watersheds that identify essential projects to restore legacy erosion sites and degraded aquatic and riparian habitats (including streams and meadows) are designed to improve overall biodiversity and ecosystem conditions.

Dams and diversions would be managed the same way in all alternatives, with their management mostly outside of the control of the Forest. There would continue to be effects to aquatic and riparian ecosystems that are fundamentally altered from their natural condition. These effects would continue to improve over time, as they have over the past few decades, as the Forest Service and other agencies work through Federal Energy Regulatory Commission relicensing projects and other processes to alter flow patterns and diversion methods to minimize effects to aquatic and riparian systems. However, these water uses are important national forest uses and they will remain fundamentally the same as the current altered condition.

All alternatives would have the same livestock management guidance. Grazing levels may change over time with changing conditions, but those decisions would be made on a project-specific basis. All permits contain language that livestock will not enter the allotment prior to range readiness. Within the plan area, California golden trout and the Mountain and Sierra yellow legged frog overlap with active allotments. Typically, spawning and egg-laying timing coincides with spring melt-off in suitable habitats and is a consideration addressed in determining the timing of “range readiness,” for grazing (see “Production Livestock Grazing” section). Nothing in any of the alternatives will change methods for determining range readiness and preventing impacts to breeding habitat.

Forest plan components include grazing management in meadows (MA -RCA-STD-10-13 and 17; MA-RCA-GDL-03 and 05). These standards and guidelines and others (DA-RNA-SUIT-08; SPEC-SHP-STD-01; RANG-FW-STD-01-07) are anticipated to improve grazing management, and result in positive meadow and riparian conservation area trends over time. These actions improve vegetative conditions, stability and resilience over time.

Consequences Specific to Alternative A

Alternative A would continue to follow the current forest plan direction of the Inyo National Forest for management of aquatic species and habitats. The aquatic management strategy would continue to provide direction for riparian habitat according to riparian conservation objectives designed to maintain the ecology of riparian areas and reduce the risk of sediment from entering aquatic ecosystems. Standards and guidelines for alternative A emphasize protecting water quality and protecting riparian conservation areas by limiting active management within a variable buffer distance around riparian features offering protections in narrow bands for species specific needs (amphibians, fish, and aquatic snails).

The emphasis on limiting active management in riparian areas, critical aquatic refuges, and meadows (which are considered to be riparian conservation areas) means that while projects will continue to minimize short-term effects to riparian and aquatic habitat, there will also continue to be a smaller-scale view of restoration, and watershed-wide restoration will be less likely to occur. Therefore, the resilience of aquatic and riparian habitat will be less than in the plan revision alternatives on a watershed scale in the long term, on a landscape scale. Alternative A has the fewest acres of riparian habitat improved, and the least number of meadows enhanced. In alternative A, prescribed fires could not originate in riparian areas, limiting the ability to return natural fire into riparian ecosystems. Further, conifer or shrub removal in meadows in less likely to occur, and there is less focus on restoration, limiting the ability to restore as many meadows.

Community wildfire safety concerns would be addressed by an emphasis on fire suppression. There would continue to be limited restoration of riparian vegetation. Few areas would have conifers removed to restore hardwood dominance where conifers have grown in and are outside the natural range of variation. Although wildfire is recognized as an essential ecosystem process, wildfire managed to meet resource objectives would generally be limited to select areas, such as wilderness and remote areas. This would reduce the ability to use natural fire to thin riparian areas that currently have very thick growth. These riparian areas often act as a conduit for severe fires during wildfire, increasing the sediment input and reducing stream stability. These effects can have major impacts to aquatic and riparian ecosystems than the more frequent, less severe fires expected forestwide under the plan revision alternatives. While effects may not be different on any individual stream, on a forestwide scale, this alternative would have the greatest potential for negative effects from uncharacteristically large and severe wildfires.

Table 50. Critical aquatic refuge name and acres in alternative A

Critical Aquatic Refuge Name	Acres in Riparian Conservation Areas	Acres out of Riparian Conservation Areas	Acres not in Riparian Conservation Areas, but within Wilderness	Total Acres
Baker Creek	4,402	15,920	2,085	20,322
Barrel Springs	563	1,265	1,264	1,828
Cottonwood Creek	7,590	21,648	17,891	29,238
Crater Meadow	2,301	4,341	4,338	6,642
Crooked Meadow	321	956	0	1,276
Dry Creek	349	1,340	0	1,688
Elderberry Canyon	502	1,845	1,581	2,348
Gable Lakes	584	1,658	1,657	2,242
Glass/Deadman/Big Springs	3,846	12,733	6,691	16,579
Golden Trout/Volcano Creeks	10,341	27,761	27,761	38,102
Haiwee Canyon	1,297	5,896	6	7,192
Harvey Monroe Hall RNA	3,557	6,761	5,189	10,318
Lead Canyon	2,519	8,631	8,631	11,150
Little Hot Creek	787	2,738	0	3,526
O'Harrel	311	1,353	0	1,664
Olancha	816	2,960	2,751	3,776
Upper Convict/McGee (Mono)	3,874	8,836	8,833	12,709
Total Acres	**43,960**	**126,642**	**88,678**	**170,600**

Sustainability of Habitat

Alternative A focuses on developing resilience to fire with prioritization of areas around communities. This alternative includes the implementation of the aquatic management strategy. Current plan direction emphasizes restoration of hydrologic connectivity but does not include specific direction for the restoration of habitat for all life stages of aquatic or riparian associates. Restoration of aquatic ecosystems is a priority for the Inyo National Forest following the “Ecological Restoration Leadership Intent” established by the Regional Forester (USDA Forest Service 2015g). Improvement of aquatic habitat conditions is primarily related to mitigating the effects of roads and addressing hydrologic connectivity.

Under this alternative, limited implementation of restoration is anticipated, leaving many areas containing at-risk aquatic species untreated. Direction under this alternative has allowed for improvements to increase ecological integrity of streams by actions such as reducing trail and road density in riparian areas and meadows and removing or mitigating effects of dispersed camping from the edges of meadows and streams. These standards and guidelines have been in place since 2004, and along with best management practices, have worked well to protect most stream habitats from sedimentation, other than sedimentation from uncharacteristic fires. Riparian and aquatic ecosystems would remain vulnerable to increased sediment input from uncharacteristically large fires without increased restoration and fuels treatment.

Ecological Connectivity

Hydrologic connectivity is addressed under this alternative through maintenance of ecological connectivity among habitats for some aquatic species and riparian associates. Restoration of ecological connectivity by improving road crossings or mitigating water diversions would be expected to occur at a slow pace under this alternative because the focus is on relatively small-scale treatments which can only improve local or reach-scale conditions.

Biodiversity

In the current plans, direction and best management practices reduce the impacts of management actions locally but do not by themselves address the biodiversity, sustainability, or persistence of aquatic and riparian associates. Plan direction is primarily prescriptive and restrictive to limit management activities that would restore forest vegetation and improve habitats that support the persistence of all life stages of aquatic or riparian species. Similarly, plan direction in alternative A does not emphasize management of invasive species or restoration of ecological connectivity as well as the other alternatives.

Resilience to Climate Change

Adaptively managing aquatic habitats for resilience to future climate change, or improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are not explicitly addressed in the current forest plans. Therefore, resilience of riparian and aquatic systems to climate change is expected to be less than in other alternatives. Climate changes may alter riparian habitats substantially (Perry et al. 2015), especially those that are outside the natural range of variation. Projects designed under the current plans incorporate actions to increase resilience to the extent they are consistent with other sections of the plan.

Riparian Vegetation

Resilience of riparian composition and structural heterogeneity to climate change and increased risk of wildfires would not be improved in alternative A except on the occasional basis. Thom and Seidl (2015) investigated the role of natural disturbance (fire, wind, and bark beetles) in riparian areas and found effects on ecosystem services were negative but effects on native riparian species diversity was positive. There is some ability to restore riparian vegetation structure and composition in alternative A but it is limited by restrictions on mechanical treatments within riparian conservation areas. Prescribed fire restrictions in riparian areas limit direct fire ignitions, which reduces the ability of fire managers to create a patchy mosaic within riparian areas to lower the risk of riparian vegetation burning at high intensity during wildfires. There is less control of fire intensity and spatial pattern of fires when they back down into riparian areas compared to when fire managers are allowed to use ignition patterns to more closely control the fire behavior. The limited amounts of restoration would result in most riparian areas continuing to trend toward a decrease in heterogeneity and degraded condition of hardwoods. Less fuel reduction within watersheds under alternative A can lead to future larger fires that burn at high intensity and impact upland and riparian vegetation and cause more intense fire in riparian ecosystems. Alternative A has the most limited area where wildfires could be managed to meet resource objectives, primarily in wilderness areas, leaving most riparian areas with an altered fire regime.

Consequences Specific to Alternative B

Alternative B improves resilience of terrestrial ecosystems to climate change by increasing the pace and scale where vegetation is being restored, decreasing the threat of large, high-intensity wildfires, and increasing the local capacity to restore vegetation and reduce fuels. Riparian conservation area widths can be adjusted to meet or improve riparian conservation area desired conditions if identified at the project level through an interdisciplinary analysis. Riparian conservation area buffers would be adjusted based on site-specific conditions and new scientific information as it becomes available.

This alternative manages the same riparian conservation areas as alternative A using the full suite of plan components (desired conditions, standards, guidelines, goals) to move riparian ecosystems toward resilience to fire and climate change. While they still use riparian conservation areas, all plan revision alternatives would adjust riparian conservation area direction relative to the current plan to allow for greater use of prescribed fire within riparian areas, and allow for more acreage of riparian restoration using a wider range of methods. The flexibility within the riparian conservation area direction is designed to reduce the negative effects of wildfire more effectively than the limited treatment approach of alternative A and alternative C. Treatments to improve fire resilience in riparian ecosystems over the long term would be guided by desired conditions, standards, and guidelines that protect water temperature, riparian vegetation and other conditions that provide quality habitat for dependent wildlife over the short term.

Alternative B provides management direction that would likely increase restoration activities or opportunities on adjacent lands and wilderness in part because of how this alternative's strategic fire management zones could have a positive effect on ecosystem integrity at the watershed scale compared to alternative A.

Alternative B would continue the use of critical aquatic refuges to protect aquatic species, using the same direction as riparian conservation areas for the critical aquatic refuge areas. Table 4 in chapter 2 shows that about 191,500 acres of critical aquatic refuges would be designated under alternative B, which is about 20,000 more acres than alternative A, with one more critical aquatic refuge designated. These are expected to help protect aquatic and riparian habitat in the short term by limiting mechanical treatments and prescribed fire within the relatively small refuges, and by requiring that all projects are analyzed to determine their effects on water quality, habitat connectivity, and riparian health. However, this alternative does not focus on watershed-wide restoration, and therefore would continue the current level of vulnerability to uncharacteristically large and severe wildfires that could severely affect riparian and aquatic habitat within and downstream of these fires.

Sustainability of Habitat

Some management activities like vegetation management and maintenance and development of infrastructure, like roads, trails and campgrounds, have the potential to cause both short- and long-term adverse impacts to aquatic and riparian habitat (Frissell et al. 2012). Desired conditions, standards, and guidelines in this alternative are designed to protect aquatic habitats. The reduction of high-intensity wildfire risk, especially within riparian areas, would improve watershed and aquatic habitat conditions over the long term compared to alternative A.

The proposed increase in ecosystem restoration is not expected to result in substantially increased amounts of sediment and other disturbances to streams. All projects would be designed to incorporate best management practices to mitigate soil and sediment impacts and would be designed to maintain or improve riparian and aquatic ecosystem desired conditions. Best management practices and standards and guidelines are designed to reduce the risk of sediment from entering aquatic ecosystems. Alternative B would allow for more improvement of watersheds and riparian ecosystem function. The goal of increasing restoration of aquatic habitats through partnerships would help increase the pace and scale of restoration under alternative B, compared to alternative A. The potential for short-term effects from the increased pace and scale of restoration would be balanced against the long-term benefits to aquatic habitats for alternative B.

Ecological Connectivity

While there is uncertainty about the magnitude of climate change, connectivity can be affected, especially where barriers block species movements. Desired conditions address the maintenance and restoration of ecological connectivity among habitats for aquatic or riparian associates. The increase in the pace of restoration compared to alternative A, especially in concert with an increased use of partnerships, should allow for an increase in the restoration of aquatic connectivity. The increase in vegetation restoration projects would increase the potential to replace and improve road culverts to improve hydrologic and aquatic connectivity. For amphibians associated with streams and meadows, connectivity requires movement between habitat islands to allow dispersal among subwatersheds.

Riparian conservation areas aim to improve conditions of stream corridors for movement and foraging habitat of at-risk species. Plan direction would guide projects that occur within riparian conservation areas to consider connectivity of riparian habitats and related needs of at-risk species. Connectivity among streams for aquatic species would improve over the landscape as undesired barriers are removed or restored to reduce fragmentation and maintenance of desired barriers to separate invasive species from native species. A greater emphasis on partnerships will result in increased resources to restore riparian and aquatic habitats and provide for greater ecological connectivity.

Biodiversity

Restoration of degraded habitats would lead to increased resilience for aquatic and riparian associates. Desired conditions address native aquatic species and encourage aquatic restoration across the landscape to provide for the persistence of species. An increase in terrestrial ecosystem restoration could have localized, short-term negative effects to aquatic and riparian associates, but would be offset by long-term benefits where actions would restore riparian vegetation, improve hydrological function or increase fire or climate change resilience.

Increased partnerships to restore riparian habitats would improve ecological conditions that support the persistence of native species and biodiversity. Existing critical aquatic refuges are managed similar to alternative A with one new critical aquatic refuge added around populations of the black toad. Desired conditions, standards, and guidelines would guide management of habitat for all aquatic species.

Alternative B has potential for localized, short-term impacts for slow-moving species concentrated in moist riparian areas due to mechanical treatments and prescribed burning. Timing of prescribed burning and other ground-disturbing activities outside of species' activity periods could minimize these effects and can be determined at the project level for specific at-risk species. Minimizing short-term consequences on aquatic species when restoring aquatic and riparian habitat in conjunction with the long-term benefits of more sustainable and resilient landscapes would improve persistence of species. Overall, the goal to increase restoration of aquatic and riparian habitats would address species needs and improve biodiversity more than alternative A.

Resilience to Climate Change

Managing aquatic habitats for resilience to future climate change and improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are addressed in the desired conditions for alternative B. Riparian plants provide shade over streams and can be restored or protected to cool streams across the landscape to counteract the warming temperatures that are already occurring. The risk of large intense fire in riparian areas would be reduced with this alternative (see "Fire Trends" section).

Riparian Vegetation

There would be more emphasis on ecosystem restoration, including riparian vegetation restoration in alternative B, than in alternative A. As national forest managers increase the pace and scale of restoration, including mechanical thinning, prescribed fire, and managing wildfire to meet resource objectives, the forests and riparian areas should become more resilient to climate change.

All restoration that results in a reduction of conifer encroachment and an increase in heterogeneity in riparian areas would move riparian vegetation composition and structure toward the natural range of variation. This would improve growing conditions for riparian hardwoods and shrubs that are often shaded out by upland trees and shrubs. Prescribed fire and wildfire managed to meet resource objectives would improve the condition, vigor and health of most native riparian plants. Many native riparian plants sprout as an adaptation to flooding and this often allows them to respond positively to fire as well (Fites-Kaufman, Bradley, and Merrill 2006, van Wagtendonk and Fites-Kaufman 2006). The trend in composition and structural heterogeneity of native species would increase. The Final Revised Plan contains plan components that address water quality in the forestwide desired conditions section (WTR-FW-DC-02 and 03), forestwide standards (WTR-FW-STD-01), riparian conservation area standards (MA-RCA-STD-01, 03, 10, 17), and riparian conservation area guidelines (MA-RCA-GDL-02). Temperature is specifically addressed in MA-RCA-STD-01. Also, while water quality was not specifically noted in every riparian conservation area and conservation watershed plan component, all plan components that aim to restore hydrologic function and riparian health would have a positive impact on water quality.

An increased emphasis on wildfire managed to meet resource objectives would continue to provide improved riparian vegetation conditions and reduce the risk of intense fire across large landscape areas, especially those in higher elevations where there are fewer opportunities for more direct restoration. The reduction in risk of severe wildfire can improve the overall resilience of these systems over the life of the plan. Alternative B would lead to more improvement of riparian ecosystem resilience to fire and climate change compared to alternatives A and C.

Consequences Specific to Alternative B-modified

Alternative B-modified updates the approach for aquatic and riparian resource conservation; it considers recently available data on aquatic biological diversity in the Sierra Nevada and the scale of megafires that have been increasing in frequency over the last 15 years. The updated approach includes plan direction for watersheds, riparian conservation areas and conservation watersheds. Conservation watersheds replace critical aquatic refuges as a management area.

Conservation watersheds are intended to maintain large landscapes where high quality water contributes to beneficial uses and conservation of at-risk species. The average size of critical aquatic refuges is 10,000 to 40,000 acres; conservation watersheds are typically larger than 40,000 acres. In alternative B-modified, four conservation watersheds encompass almost 379,000 acres. Table 51 shows the acreage of conservation watersheds across the Inyo National Forest under alternative B-modified.

Because conservation watersheds operate at larger scale, they are expected to provide better resilience in the face of large wildfires. Conservation watersheds include plan direction using indicators and measure to reach desired conditions (MA-CW-DC-01-03), objectives to improve landscape conditions (MA-CW-OBJ-01), standards for balancing recreation uses (MA-CW-STD-01), and guidelines that accept short-term effects when long-term objectives are supported (MA-CW-GLD-01-03) that increase the pace of restoration. Also potential management approaches prioritize restoration work in conservation watersheds. The four conservation watersheds (table 51) associated with Alternative B-modified can be recommended for future consideration as part of the National Fish and Aquatic Strategy[26] as criteria are developed to select conservation watersheds across all national forests and grasslands by 2020. Partnership with local clubs, schools, and Tribes as well as grant funding through state and national fish, wildlife, and motorized have ongoing investments within these four conservation watersheds and are expected to continue.

Conservation watersheds will complement, not replace, priority watersheds identified through the agency's 2011 Watershed Condition Framework. By definition, priority watersheds under the Watershed Condition Framework are designated as such for relatively short periods of time (3 to 5 years) chosen to improve an indicator's functional rating. In contrast, implementation of conservation watershed direction is intended to help protect and maintain functioning aquatic systems as well as restore degraded watersheds, which will benefit aquatic and riparian resources over the long term. The forestwide watershed plan components are designed to maintain or improve overall functional character and the Watershed Condition Framework provides the data necessary to measure such progress.

Table 51. Acres of conservation watersheds under alternative B-modified

Conservation Watershed	Acres in Riparian Conservation Areas	Acres out of Riparian Conservation Areas	Acres not in Riparian Conservation Areas, but within Wilderness	Total Acres
Cottonwood-Crooked Creek Headwaters	15,070	47,646	26,784	62,716
Middle Fork San Joaquin River Headwaters	17,606	31,070	28,395	48,676
Mono Lake Headwaters	23,372	60,515	39,180	83,887
South Fork Kern River Headwaters	45,275	138,173	124,902	183,447
Total Acres	**101,323**	**277,404**	**219,262**	**378,727**

The change to conservation watersheds from current critical aquatic refuges (alternative A) is that 13 out of the 17 critical aquatic refuges (table 50) do not overlap with conservation watershed boundaries. However, 10 of the 13 contain federally listed species that are protected under the Endangered Species Act and 8 of these critical aquatic refuges are currently provided protections by designated critical habitat. The remaining 6 refuges not within conservation watersheds have species coverage by relevant plan components under special habitat (see Terrestrial Vegetation direction), riparian conservation areas, and/or species specific plan components. Unlike critical aquatic refuges that focused on aquatic species, conservation watershed plan direction recognizes the value of biodiversity collectively in adjacent uplands habitat and aquatic and riparian

[26] https://www.fs.fed.us/naturalresources/fisheries/resources/risetothefuturestrategynov2017.pdf

ecosystems and incorporates direction that supports long-term functionality of these terrestrial systems (MA-CW-GDL-01).

Alternatives B, B-modified, C, and D all propose increased use of wildland fire for ecological benefit. This activity can occur in designated wilderness, promoting ecological restoration of the conservation watersheds. In terms of actual active watershed restoration, current Forest Service manual direction limits what can be done in wilderness areas:

> Watershed improvements may be used to restore watersheds where deteriorated soil and hydrologic conditions caused by humans or their influences create a serious threat or loss of wilderness values. Watershed condition improvements are also appropriate where natural conditions present a definite hazard to life or property; or where such conditions could cause serious depreciation of important environmental qualities outside of the wilderness. Promote natural healing where such dangers are not imminent or where natural vegetation would return in a reasonable time (FSM 2300, Chapter 2323.43).

Restoration activities or opportunities on adjacent lands and wilderness in part can occur because of how strategic fire management zones could have a positive effect on ecosystem integrity at the watershed scale compared to alternative A.

Only Cottonwood-Crooked Creek Headwaters conservation watershed contains alternatives B and B-modified proposed wilderness designation (see table 52). This would have nominal effects because alternative B-modified provides management direction that would likely increase restoration activities on adjacent lands and wilderness compared to alternative A, which would be beneficial to watershed condition ratings.

Table 52.Proposed wilderness areas within Cottonwood-Crooked Creek Headwaters conservation watershed

Proposed Wilderness Area (Alternatives B, B-modified)	Total Acres	Acres in Conservation Watershed	Percentage in Conservation Watershed
White Mountain Wilderness Addition - West	5,062	4,999	99 percent
White Mountain Wilderness Addition - East	2,505	2,482	99 percent

The Final Revised Plan contains plan components that address water quality in the forest wide desired conditions section (WTR-FW-DC-02 and 03), forest wide standards (WTR-FW-STD-01), riparian conservation area standards (MA-RCA-STD-01, 03, 10, 17), and riparian conservation area guidelines (MA-RCA-GDL-02). Temperature is specifically addressed in MA-RCA-STD-01. Also, while water quality was not specifically noted in every riparian conservation area and conservation watershed plan component, all plan components that aim to restore hydrologic function and riparian health would have a positive impact on water quality.

Sustainability of Habitat

Unlike critical aquatic refuges, the conservation watersheds include entire hydrologic systems from headwaters to community water districts, in management areas beyond wilderness and inventoried roadless area land allocations. Inclusion of public lands near or adjacent to wilderness and inventoried roadless areas can maximize benefit to conservation watershed; an assumption based on the conservation biology literature where scale helps achieve landscape connectivity. Based on adjacency and the large scale landscape approach, conservation watersheds capture greater diversity of habitats that allow for desired conditions to be achieved and sustained, over the long term.

If proposed White Mountain East and West additions are designated wilderness, approximately 7,481 acres would limit future development of roads and infrastructure resulting in preservation of existing suitable habitat and connectivity within Cottonwood-Crooked Creek Headwaters conservation watershed. Although it would maintain or improve the watershed condition framework rating, fuels reduction and restoration could be impeded.

Unmanaged recreation can adversely affect aquatic and riparian ecosystem integrity caused by user-created trails, dispersed camping, and motorized vehicle use outside of designated travel routes. Likewise, as the trend of visitors increases, managed recreation could result in negative impacts and require more maintenance of authorized trails and camps in aquatic and riparian ecosystems. Sustainable recreation presented in alternative B-modified could provide for expansion of recreational opportunities under the General Recreation Area. Recreation direction within conservation watersheds requires that any site-specific activities that occur within the Destination or General Recreation Areas will continue to promote the maintenance or restoration of the Watershed Condition Framework indicators (MA-CW-STD 01). Recreation opportunities such as hunting, hiking, pack stock use, fishing and other water-based opportunities would likely enhance areas associated with aquatic systems (hardening water crossings, bridge maintenance, and creek crossings) from watershed improvements done in conservation watersheds as the health of watersheds is improved.

Although alternative B-modified emphasizes fire's role in restoring ecological integrity to the landscape and would moderate the upward trend of wildfire frequency and intensity, the effects of climate change and insect and disease outbreaks over the long term increase the risk of high-intensity wildfire over current conditions. The emphasis on restoring low- and medium-intensity fires across the landscape within conservation watersheds would include riparian areas, limit the accumulation of fuels, restore understory plants of cultural importance to Tribes, and encourage vigorous riparian habitats.

Ecological Connectivity

Conservation watersheds are made up of multiple HUC 12 watersheds to the point that the sum total meet several criteria such as beneficial downstream uses, biodiversity and opportunity of projects. In the plan area 143 HUC 12 watersheds occur. Of these, 118 overlapped with inventoried roadless areas and out of those, 84 overlapped with wilderness. The four selected conservation watersheds connect aquatic and riparian habitats and serve as corridors thus providing ecological connectivity at the landscape scale. Connectivity is important for migration of game species like deer and bear who travel great distances from winter grounds to summer grounds. Local and migrating bird, bat and pollinator species rely on connected riparian corridors for dispersal, foraging, and breeding habitat. Surface and groundwater systems important to aquatic biota are often interconnected hydrologic systems connecting or supporting headwater, springs, meadows and seeps. Use of HUC 12 watersheds are assumed to contain these interconnections that contribute to the overall quantity of water within such basin.

The importance of a landscape-scale approach to establish functioning aquatic and riparian ecosystems is now pervasive in the literature. Proposing new critical aquatic refuges and having existing critical aquatic refuges at high elevation may not serve to restore large rivers and lower elevation habitats for aquatic species (Frissell et al. 2012). In the Sierra Nevada, one of the first considerations of this approach was in Moyle (1996). This approach was used in the Northwest

Forest Plan based on the report of the Forest Ecosystem Management Assessment Team (FEMAT) in July 1993. It is a fundamental premise for the National Fish Habitat Partnership (http://www.fishhabitat.org/) in advancing aquatic and riparian conservation across the country. In addition, literature has emerged over the last 20 years that suggests that positive synergies can be achieved when managing both for forest (terrestrial) and aquatic outcomes. Over 20 years of monitoring of management outcomes that were informed by large landscape scale planning have demonstrated that such an approach contributes to maintenance and restoration of aquatic systems. For instance, enhancing the connectivity of riparian species (water birch, narrow-leaved cottonwood, and black oak) and priority habitats unique to Inyo National Forest would encourage genetic diversity and dispersal to enhance resilience. While some of this literature does not focus on the Sierra Nevada per se, much is applicable.

Ecological connectivity criteria was used to select for conservation watersheds. The difference is conservation watersheds provide for resilience to large-scale, unpredictable events over four contiguous areas and twice the acreage as compared to 17 noncontiguous areas of critical aquatic refuges. The cumulative beneficial effects of restoration on ecological connectivity within conservation watersheds are expected to be greater than in critical aquatic refuges because of this difference in scale. Therefore, alternative B-modified could result in more connectivity associated with conservation watersheds than all other alternatives.

Biodiversity

Biodiversity is addressed in this alternative through the consideration of conservation watersheds, which include both terrestrial and aquatic at-risk species and special aquatic features within functioning watersheds (see Development of Conservation Watersheds for the Inyo National Forest 2017, project record)). Under alternatives A, B, C, and D, diversity is limited to aquatic species within critical aquatic refuge designation. When critical aquatic refuges were designated, Yosemite Toads and yellow-legged frogs were not federally listed. They are now listed as federally endangered or threatened, along with Paiute and Lahontan cutthroat trout, which have been listed for decades. Where critical aquatic refuges now have federally listed species, there exist Endangered Species Act requirements to regulate the management of these species regardless of which alternative is selected. Plan standards (which are mandatory constraints on national forest actions), are included for at-risk species that critical aquatic refuges were developed around including Yosemite toad and yellow-legged frogs (SPEC-AMPH-STD), golden trout (SPEC-GT-GOAL), Lahontan cutthroat trout (SPEC-LTC-STD). Aquatic and riparian special habitats (desert springs, seeps, and fens) are considered special aquatic features and relevant plan components are in the "Riparian Conservation Area" section of the plan. These special habitat components provide greater protection than critical aquatic refuges for spring snails, for example, but are inclusive of native plants, pollinators, long-term sustainability (TERR-SH-DC-01-03), and management priority. They provide greater protection by improving watershed resilience to climate change, fire and other unpredicatable events, while providing the same short-term protection during project implementation.

The diversity of at-risk plant species was a driver for designating conservation watershed areas. A high level of species richness and biodiversity is expected in conservation watersheds because they score high in overall condition rating in water quality and quantity, which are critical elements for most living organisms. In properly functioning watersheds, aquatic and riparian systems are expected to provide for biodiversity. Conservation watersheds capture a diversity of habitats (including terrestrial upland) expected to provide suitable habitat necessary for various life stages particularly those that experience metamorphism like amphibians or butterflies. One of the main drivers for designating cottonwood-crooked creek headwaters conservation watershed was the diversity of at-risk plant species. Including upland habitat with aquatic and riparian systems provides for overwintering, foraging of pollinator plants and use of migration corridors for dispersal. Monitoring watershed condition indicators like aquatic biota condition and forest health condition can be important indicators of species diversity which did not happen with critical aquatic refuges. Therefore alternative B-modified is expected to provide for biodiversity compared to all other alternatives.

Resilience to Climate Change

The large scale of conservation watersheds compared to critical aquatic refuges is the primary difference between all other alternatives in regards to climate change. Without more active watershed-level restoration as well as restoration of aquatic habitat, no increase in habitat or species resilience to climate change would occur (Moyle et al. 2013, Viers et al. 2013). To highlight the differences, conservation watershed acres would be 387,680 versus 191,010 for critical aquatic refuges. One conservation watershed is located in White Mountain landscapes which benefits Nevada as well as California; none of the critical aquatic refuges provided this.

This alternative would reduce the risk of high-intensity wildfire impacts to riparian areas and adjacent uplands as well as other alternatives due to the decreased area with fuel reduction treatments. Where changes in temperatures and amounts and timing of precipitation have led to earlier peak stream flow rates in most Sierra Nevada streams, with higher spring flows and lower summer flows will be more detectable within conservation watersheds than critical aquatic refuges. If overall precipitation increases over time, streamflow volumes during peak runoff will increase even more, leading to notably higher flood risk in downstream areas forest priorities may shift to protect such infrastructure and resources. As national forest managers increase the pace and scale of restoration, including mechanical thinning and increasing the use of managed wildfire to meet resource objectives, riparian areas would become more resilient to climate change. Therefore, alternative B-modified differs slightly from all other alternatives if pace and scale of restoration in conservation watersheds occurred; the result broadens the level of resilience to climate change.

Riparian Vegetation

All alternatives provide riparian vegetation management and protections using both priority watersheds and riparian conservation areas. Alternative B-modified differs in using conservation watersheds and eliminating critical aquatic refuges. Because of the conservation watershed focus (MA-CW-CDL, MA-CW-DC) on restoring entire watersheds across various ecosystem types, it should help improve watershed conditions on a watershed scale and better protect from large, severe fires, heavy rainfall, and other events. While the emphasis on restoration within riparian conservation areas and conservation watersheds, and reduction of fuels and return to natural fire intervals may have some short-term effects, the plan explicitly accepts these impacts in order to improve the overall long-term functionality of watersheds. This should help protect and enhance riparian habitat greater than the other alternatives.

The emphasis on project activities, both restoration and other uses, would be designed to attain functional watershed condition indicators; have short-term, site-specific impacts that support the long-term functionality of systems; and reduce impacts. Although similar to alternatives B, C, and D, alternative B-modified plan direction provides latitude and flexibility with the intent to increase the pace and scale of restoration in riparian areas, meadows, and streams.

Consequences Specific to Alternative C

Alternative C would have the least restoration using mechanical treatment of all alternatives, and an increased emphasis on the use of prescribed fire and managing wildfires to meet resource objectives. Riparian conservation areas would be managed similar to alternative B. Although there is more emphasis on managing wildfire to meet resource objectives proposed for alternative C, there is a high uncertainty about how much would actually occur because of low levels of mechanical restoration used to create strategic areas to “anchor” large prescribed fires and wildfires managed to meet resource objectives. If there is more fire, there could be a greater benefit in alternative C, because more small fires and prescribed fires could reduce sediment input relative to larger, more severe wildfires. The benefit would be in more limited locations compared to the other alternatives and the intensity of prescribed fire might be higher than in the other alternatives due to higher densities of fuels being burned without any previous mechanical treatment to thin before burning.

In alternative C, the Wildfire Maintenance Zone would be the most likely to have benefits to wilderness characteristics, where wildfires could be safely managed while still restoring fire as an ecosystem process. The general wildfire zone may make it more difficult to evaluate wildfire risk resulting in slightly less wildfires managed to meet resource objectives within existing wilderness areas.

Sustainability of Habitat

Desired conditions, standards, and guidelines in alternative C would provide for maintenance of aquatic habitat and protections of aquatic habitats. The large-scale landscape approach has the potential to address national forest infrastructure such as roads, trails, and dispersed campgrounds within sensitive areas. This should improve watershed and aquatic habitat conditions over the long term compared to alternative A. The goal of increasing restoration of aquatic habitats through partnerships would help increase the pace and scale of restoration under alternative C, when compared to A. Equipment use would be more restricted in riparian conservation areas compared to the alternatives B, B-modified, and D. The potential for short-term effects from the increased pace and scale of restoration under alternatives B, B-modified, and D would be reduced under alternative C. Alternative C would increase new critical aquatic refuges compared to alternatives A, B, and D, although most of them are in existing designated wilderness areas or areas recommended for management as wilderness. The goal to restore aquatic habitat could improve the resilience and sustainability of aquatic and riparian habitat under alternative C and is similar to alternative B-modified.

Simply setting aside critical aquatic refuges does not in itself improve resilience and sustainability of aquatic habitats and ecological integrity. Proposing new critical aquatic refuges and having existing critical aquatic refuges at high elevation may not serve to restore large rivers and lower elevation habitats for aquatic species (Frissell et al. 2012). The increase in the number of stream miles restored and meadows restored under this alternative would increase the pace of restoration compared to alternative A, but would not be sufficient to achieve the restoration needed to reverse past legacy land use degradation of habitat. Restoration of aquatic habitat with partners could improve sustainability and resiliency of aquatic ecosystems to climate change.

Ecological Connectivity

Alternative C would provide for ecological connectivity among habitats for aquatic or riparian associates similar to alternative A, but with more emphasis on restoring connectivity associated with critical aquatic refuges. There would be less potential for short-term impacts to connectivity from restoration compared to alternatives B and D, but there would also be less potential to restore aquatic connectivity related to existing roads compared to those alternatives and as compared to alternative B-modified. Goals to address aquatic restoration including restoring connectivity and increasing the involvement of partners and stakeholders would help improve connectivity of habitat similar to alternatives B and D.

Biodiversity

Alternative C identifies additional areas as critical aquatic refuges in watersheds that contain at-risk aquatic species. Aquatic restoration could be focused on habitat to maintain biodiversity or at-risk species, especially in conjunction with restoration in priority watersheds. With restoration of aquatic habitats, aquatic diversity is expected to be sustained or increase in the short term. However, the long-term consequences of this alternative would be an increased risk of large, high-intensity fire. Intense wildfire can have a negative effect on aquatic and riparian species. Although these effects are generally short lived, landscape changes in forest vegetation from large wildfires has longer consequences. Like alternatives B, B-modified, and D, the goal to increase restoration of aquatic habitats would address species needs and improve aquatic biodiversity.

Resilience to Climate Change

Adaptively managing aquatic habitats for resilience to future climate change, or improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions are addressed in this alternative similar to alternatives B, B-modified, and D.

Adaptively managing aquatic habitats for resilience to future climate change, or improving adaptive capacity of aquatic ecosystems through ecological restoration and climate adaptation actions would be hampered if sustainability and resilience to climate changes in the rest of the watershed and landscape are not restored.

Riparian Vegetation

Limited restoration using mechanical treatments and an increased emphasis on fire, both prescribed and wildfire managed to meet resource objectives, would be the basis for managing riparian areas under this alternative. Although there is more managed wildfire proposed for alternative C, there is a high uncertainty how much would occur because of low levels of mechanical restoration used to create strategic areas to "anchor" large prescribed fires and wildfire managed to meet riparian resource objectives. If there is an increase in low- to moderate-intensity wildfire, there could be a benefit to riparian species and composition in alternative C similar to alternatives B, B-modified, and D. However if the rate of managed wildfire and prescribed fire remains low, then riparian vegetation restoration and improvement in ecological conditions would not be achieved as well as in alternatives B, B-modified, or D. Overall, there is substantially less vegetation restoration in alternative C.

Consequences Specific to Alternative D

Alternative D would treat more area in total than alternatives B, B-modified, and C. The modified approach for riparian conservation areas would be the same as alternatives B and B-modified. Increased use of mechanical equipment in the riparian conservation areas would be designed to improve conditions of riparian areas, especially to restore fire within the landscape and riparian areas. Fuel reduction treatments are designed to reduce risks of wildfire more effectively than the scattered treatment approach of alternative A and limited treatment approach of alternative C. Alternative D plans to improve resilience of terrestrial ecosystems to climate change by increasing the rate and extent of the land area where vegetation is being restored, decreasing the threat of large, high-intensity wildfires; and increasing the local capacity to restore vegetation and reduce fuels. As national forest managers increase the pace and scale of restoration, including the use of mechanical thinning and increased area where wildfires are managed to meet resource objectives, the national forest should become more resilient to the effects of climate change, especially increases in wildfire. Alternatives D would provide management direction that would likely increase pace and scale of restoration activities on adjacent lands to existing wilderness compared to alternative A, which would be beneficial to working in critical aquatic refuges that overlap existing wilderness.

Sustainability of Habitat

The large-scale landscape approach under alternative D has the potential to address national forest infrastructure such as roads, trails, and dispersed campgrounds within sensitive areas to a greater degree than alternative B, and is similar to alternative B-modified. This should improve watershed conditions over the long term compared to alternatives A, B, and C. Vegetation management activities and maintenance and development of infrastructure, like roads, have the potential to cause both short- and long-term adverse impacts to habitat (Frissell et al. 2012). Desired conditions, standards, and guidelines would provide for maintenance of aquatic habitat and protections of aquatic habitats. The proposed increase in ecosystem restoration, including increased allowance for equipment use in riparian conservation areas would not be expected to result in substantially increased amounts of sediment and other disturbances to streams. All projects would be designed to incorporate best management practices to mitigate soil and sediment impacts and projects would be designed to maintain or improve riparian and aquatic ecosystem desired conditions. The goal of increasing restoration of aquatic habitats through partnerships would help increase the pace and scale of restoration under alternative D, as compared to A. The potential for short-term effects from the increased pace and scale would be balanced against the long-term benefits to aquatic habitats for alternative D.

Alternative D would reduce the risk of uncharacteristically large wildfires, thus reducing the risk of undesirable short-term impacts to aquatic ecosystems while still allowing for the historically beneficial role of fire to be expressed. The goal of encouraging restoration of habitats using partnerships could address many legacy restoration needs in areas prioritized for species and is similar to alternatives B, B-modified, and C.

Ecological Connectivity

Desired conditions in alternative D address the maintenance and restoration of ecological connectivity among habitats for aquatic or riparian associates, and an increased pace and scale of restoration compared to alternatives A, B, B-modified, and C. With an increased use of partnerships, this alternative should allow for the greatest increase in the number of projects designed to protect aquatic connectivity. The increase in vegetation restoration projects would increase the potential to replace and improve road culverts to improve hydrologic and aquatic connectivity more than in the other alternatives.

Riparian conservation areas would provide conditions for species to use these areas close to streams as corridors for movement and foraging habitat. Plan direction would guide projects that occur within riparian conservation areas to consider connectivity of riparian habitats and the needs of at-risk species. Connectivity among streams for aquatic species would improve over the landscape as undesired barriers are removed to reduce fragmentation and desired barriers are maintained to separate invasive species from native species.

Biodiversity

An increase in terrestrial ecosystem restoration could have localized, short-term negative consequences to aquatic species, particularly where mechanized treatments are used to restore riparian vegetation, and roads are reopened to accomplish restoration actions. This alternative may have negative short-term consequences for species concentrated in moist riparian areas, but these short-term consequences on riparian biodiversity are balanced favorably against the long-term benefits of creating more sustainable landscapes that have more resilience to changes from wildfire, climate change, and other stressors. The goal to support aquatic restoration using partnerships would encourage restoration of aquatic habitat to improve persistence of species and sustain aquatic diversity.

Resilience to Climate Change

As national forest managers increase the pace and scale of restoration, including mechanical thinning and increasing the use of wildfire managed to meet resource objectives, riparian areas should become more resilient to climate change. The risk of large intense fire on riparian areas would be reduced the most with this alternative because of the increased amount of planned restoration in the riparian areas and adjacent upland vegetation and surrounding watersheds. Restoration and protection of aquatic habitat would improve resilience as in alternatives B, B-modified, and C but on an increased number of acres under alternative D. Increased fire resilience would confer long-term benefits to watersheds and riparian areas more than all other alternatives.

Riparian Vegetation

With the increased pace and scale of restoration in this alternative, riparian areas should become more resilient to fire and the vegetation community would more closely reflect the natural range of variation. There would be similar environmental consequences to alternatives B and B-modified, but with more riparian area restored. The greater amount of area proposed for restoration in alternative D would result in a greater amount of riparian area restoration in sagebrush and pinyon-juniper, and all montane areas. All of these areas would be the focus of both mechanical and prescribed fire restoration treatments in uplands. Both upland and adjacent riparian areas would be incorporated in large landscape projects. Upper montane riparian areas would have more restoration of wildfire primarily to meet resource objectives. In all of these types of restoration, there would be beneficial impacts to composition, structure, and function of riparian vegetation. There would be a decrease in conifer or upland shrub density and cover that is outside the natural range of variation and an increase in heterogeneity. There would be increased light for hardwood shrubs, trees and understory plants. The likelihood of large, high-intensity fires would decrease under this alternative in many areas of the landscape compared to all other alternatives (see “Fire Trends” section).

Cumulative Effects

The geographic area included in this section is the southern Sierra Nevada, and the White and Inyo Mountains. For aquatic ecosystems, the long-term cumulative effects of future management actions across the landscape would continue to emphasize protection of water quality and riparian ecosystem function while increasing resilience to disturbance. At lower elevations, user-created motorized trails, motorized trails in riparian areas and adjacent to meadows, and dispersed recreations sites on streams and adjacent to meadows can influence aquatic habitat and ecological integrity and would be a focus for restoration when opportunities exist. Dams on major rivers and Los Angeles Department of Water and Power water use and management practices from the eastern slope of the Sierra Nevada would continue to have effects on connectivity of habitat and biodiversity within aquatic ecosystems. Commercial livestock grazing opportunities on the Inyo National Forest will continue to be constrained at or near current levels.

Recreational fishing is a valued pastime in the Sierra Nevada and is expected to continue, although some changes would occur as State wildlife agencies adjust their policies and practices. Introductions of nonnative rainbow, brown, and brook trout for sport fishing will continue to be a management challenge for native trout. Native fish will continue to decline if conditions begin to dry and get too warm and dams prevent species from seeking refuge at higher elevation. Another management challenge that relies greatly on continued research and adaptive management principles while our knowledge increases are the effects to aquatic and riparian ecosystems caused by disease, pathogens and aquatic invasive species.

Analytical Conclusions

Sustainability of Habitat

The Inyo reconsidered the utilization of critical aquatic refuges (alternatives A, B, C, and D) based on several factors: direction for critical aquatic refuges was too restrictive, prescriptive, and there was limited connectivity of habitats. Alternative B-modified contains flexible plan components, includes terrestrial upland habitat, and uses a larger-scale landscape approach via conservation watersheds to capture greater diversity of habitats that allows for desired conditions to be achieved and sustained, over the long term. Conservation watersheds will complement, not replace or take away from priority watersheds or riparian conservation areas.

Ecological Connectivity

Unlike critical aquatic refuges (alternatives A, B, C, and D), the conservation watersheds (alternative B-modified) include entire hydrologic systems from headwaters to community water districts, in management areas beyond wilderness and inventoried roadless area land allocations. Inclusion of public lands near or adjacent to wilderness and inventoried roadless areas can maximize benefit to conservation watershed; an assumption based on the conservation biology literature where scale helps achieve landscape connectivity. The cumulative beneficial effects of restoration on ecological connectivity within conservation watersheds (alternative B-modified) are expected to be greater than in critical aquatic refuges because of this difference in scale.

Biodiversity

Under alternatives A, B, C, and D, biodiversity was limited within the critical aquatic refuges designation, as these only addressed aquatic fish, amphibian, and snail species, some of which are now federally listed. Alternative B-modified provides for biodiversity among living organisms including at-risk plants, pollinators, and terrestrial and aquatic vertebrates and ecosystems.

Resilience to Climate Change

Alternative B-modified differs slightly from all other alternatives if pace and scale of restoration in conservation watersheds occurs; cumulative beneficial effects at a large-scale landscape broadens the level of resilience to climate change.

Riparian Vegetation

The emphasis on project activities, both restoration and other uses, would be designed to attain functional watershed condition indicators; have short-term, site-specific impacts that support the long-term functionality of systems; and reduce impacts. Although similar to alternative B, C, and D, alternative B-modified plan direction provides latitude and flexibility with the intent to increase the pace and scale of restoration in riparian areas, meadows, and streams.

Wildlife, Fish and Plants

Introduction

The diverse landscapes of the Inyo National Forest provide a rich assortment of ecosystems and habitat types that supports thousands of wildlife, fish, and plant species. These diverse landscapes are primarily indicative of the east side of the Sierra Nevada with portions along the crest and with smaller areas that are similar to those found on the west side of the Sierra Nevada. Elevations extend from approximately 3,800 feet to 14,494 feet above mean sea level at Mount Whitney. The ecological conditions on the Inyo are shaped by a variety of topography, geology and soils, influenced by a wide range of precipitation and temperature regimes. As stated previously, the Inyo National Forest contains all or part of 125 HUC-12 watersheds that are generally between 10,000 to 40,000-acres in size. There is an estimated 1,640 miles of permanent streams (USDA Forest Service 2013a). The diversity is also reflected by three major biological provinces: Sierra Nevada Mountains, Great Basin Desert, and Mohave Desert. This diversity of habitats supports the following species diversity: approximately 300 wildlife species consisting of 160 birds, 100 mammals, 30 reptiles, 10 amphibians, and 4 native fish species; countless invertebrates; and more than 1,300 plant species (USDA Forest Service 2013a).

The analysis presented in this section is subdivided into three subsections: at-risk terrestrial species, at-risk aquatic species and at-risk plant species.

The Evaluation of At-risk Species

Forest plans are developed to guide the maintenance or restoration of the structure, function, composition, and connectivity of ecosystems; to provide ecological conditions that will maintain a diversity of plant and animal communities, and support the persistence of most native species in the plan area. This analysis focuses on evaluating the consequences of the plan alternatives on at-risk species. Forest Service at-risk species include two categories: (1) federally designated species listed as threatened or endangered, species that are proposed or candidates for federal listing, and species with proposed or designated critical habitat, and (2) Forest Service-designated species of conservation concern.

In contrast to categories of federally designated species described and derived under the Endangered Species Act, species of conservation concern is a new category developed and used by the Forest Service under the 2012 Planning Rule to describe animal and plant species that are known to occur in the plan area, and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area.[27] In coordination with the Inyo National Forest, and pursuant to responsibilities and authority under the 2012 Planning Rule (36 CFR 219.7(c)(3)), the Regional Forester determined the terrestrial wildlife, aquatic wildlife, and plant species of conservation concern for the Inyo National Forest. Designation of these species is not a forest plan decision. The Regional Forester has authority to change species of conservation concern lists to reflect new information.[28] The Forest Service “sensitive species” concept is not carried forward as part of the 2012 Planning Rule and species of conservation concern replaces that concept in land management plans going forward. The land management plan includes plan

[27] 36 CFR 219.9

[28] See Forest Service Handbook 1909.12 chapter 20, section 21.22b

components that help provide ecological conditions for these species and the Final Environment Impact Statement evaluates the effects of management on these species.

The primary context for the evaluation of at-risk species, including species of conservation concern, is that forest plan components for ecological conditions provide for ecosystem integrity and ecosystem diversity. The 2012 Planning Rule requires that forest plan direction be integrated across resources and that the plans need to provide for the ecological conditions that will provide for the persistence of at-risk species within the inherent capabilities of the national forest plan area (36 CFR 219.5 and 219.8-219.9). This evaluation of plan direction that provides for species persistence is done first by examining the ecosystem level plan direction and then individual species-specific plan direction is added if needed. For the purpose of this analysis, a viable population is defined as a population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments (36 CFR 219.19). However, for many species of conservation concern on the Inyo National Forest there is uncertainty as to whether a viable population truly exists, in those cases we assess implementation of plan components on individuals and how well the alternatives address known threats to persistence. Several at-risk species have only a few known occurrences on the Inyo National Forest and have limited potential habitat. In some cases, little is known about the distribution of species that are not well surveyed.

The basis for the analysis of at-risk species requires a determination of whether plan components such as desired conditions, objectives, standards, guidelines, and goals support direction to provide the ecological conditions necessary to contribute to the recovery of federally recognized species and maintain the persistence of species of conservation concern within the plan area. Plan components were developed in an iterative way, including identifying desired conditions and potential threats to species, and identifying whether proposed plan components are sufficient to address species and their habitat needs (Forest Service Handbook 1909.12 12.52, c-d). It is recognized that due to circumstances that are either not within the authority of the Forest Service or not consistent within the inherent capability of the land, the plan area may be unable to provide the ecological conditions necessary to maintain a viable population of a particular species. The analysis also discloses the uncertainty of moving towards desired conditions given the wide departure of the current condition in some areas and the limited opportunity for restoration treatments on the Inyo National Forest. When this occurs, the analysis documents this and where possible, focuses on other efforts that are within the capability and authority of the Forest Service.

Revising the forest plan does not have direct effects because the forest plan provides a strategic framework for planning but no actions are compelled or authorized by the forest plan decision. The analysis of consequences considers indirect and cumulative effects that could reasonably result from implementation of the plan overall.

Conservation Planning As It Relates To Forest Plans

Conservation strategies and assessments provide science-based guidance for conserving and recovering species and their habitat. Typically, these are developed as decision-support tools to implement conservation measures to achieve conservation goals and objectives specific to a single or logical grouping of species. Because scientific information is constantly evolving under continually changing conditions, an adaptive planning framework is necessary to allow for adjustments in conservation strategies over time.

Conservation strategies and assessments, as opposed to conservation agreements, are not themselves "decision" documents because they have not undergone environmental analysis and public review. In addition, management recommendation in conservation strategies are often developed to optimize benefits to the species regardless of the authority and responsibility of the Forest Service and other multiple-use considerations. Where appropriate, the forest plan alternatives have incorporated some of the science-based management recommendations from various strategies and assessments, but the elements incorporated may vary by alternative. These documents are referenced because they serve as a tool to guide forest plan development.

The various conservation strategies, assessments, and agreements and approved species recovery plans and other related recovery documents are also used by forest managers when analyzing the consequences of site-specific project activities. These guiding documents are expected to be revised, replaced, or supplemented as new scientific information based on new data and reports becomes available over time. Therefore, the list below only includes those documents known to be available at this time and is not intended to be a complete or exhaustive list.

- Bi-State Action Plan: Conservation of the Greater Sage-Grouse Bi-State Distinct Population Segment[29] (Bi-State Technical Advisory Committee Nevada and California 2013)
- Conservation Agreement for *Abronia alpina* (Ramshaw Meadows abronia) (USDA Forest Service, USDI Fish and Wildlife Service 2015)
- Lahontan cutthroat trout (*Oncorhynchus clarki hensawi*) Recovery Plan (USDI Fish and Wildlife Service 1995a)
- Mountain Yellow-legged Frog Conservation Assessment for the Sierra Nevada Mountains of California, USA (Brown et al. 2014)
- Owen Basin Wetland and Aquatic Species Recovery Plan Inyo and Mono Counties, California (United States Department of the Interior 1998)
- Revised Recovery Plan for the Paiute Cutthroat Trout (*Oncorhynchus clarkia seleniris*) (United States Department of the Interior 2004)
- Sierra Nevada Bighorn Sheep (*Ovis candensis sierrae*) Recovery Plan (United States Department of the Interior 2007)
- Willow Flycatcher Conservation Assessment (Green, Bombay, and Morrison 2003)
- Yosemite Toad Conservation Assessment (Brown et al. 2015)

Federally Listed and Candidate At-risk Species

For each at-risk species that is federally listed or a candidate for listing, we evaluate whether alternatives (1) maintain or restore habitats in the plan area to provide the ecological conditions necessary to contribute to recovery of threatened and endangered species, and (2) contribute to preventing candidate species from becoming federally listed in the future.[30]

[29] The term Bi-State distinct population segment was used when the greater sage-grouse was proposed for federal listing under the Endangered Species Act. Since listing was not warranted, the term distinct population segment is not relevant and the population is now referred as the Bi-State population of greater sage-grouse.

[30] Forest Service Handbook 1909.12

When developing ecosystem and species-specific plan components to conserve federally listed species, we:

- Considered recovery actions and recovery tasks in approved recovery plans for listed species.
- Considered limiting factors and key threats to species identified in published rules from the U.S. Fish and Wildlife Service for species listing and designation of critical habitat
- Considered limiting factors and key threats to whitebark pine identified in candidate species assessments from the U.S. Fish and Wildlife Service.
- Solicited and considered comments and feedback from the U.S. Fish and Wildlife Service in the evaluation of plan components designed to conserve federally listed species.
- Considered collaboration and cooperation beyond the plan area boundary with the U.S. Fish and Wildlife Service, States, Tribes, other partners, landowners, and land managers to support an all-lands approach to conserve proposed and candidate species.
- Considered conservation measures identified in existing conservation strategies relevant to federally listed species in the plan area.

Some existing forest plan directions has been retained because it supports existing conservation measures or conservation recommendations from past biological opinions. For example, the 2014 Programmatic Biological Opinion for the Sierra Nevada Yellow-legged Frog, northern distinct population segment of the mountain yellow-legged frog and Yosemite toad applies to ongoing project activities under the current forest plan direction. Some, but not all, of this direction was applied as ecosystem or species-specific plan components, primarily because of clarifications in the definition of plan components in the 2012 Planning Rule. In some cases, existing forest plan direction was rewritten to provide flexibility to adapt to site conditions that can vary widely when direction is applied at the project level.

A biological assessment for the preferred alternative has been prepared and submitted to the U.S. Fish and Wildlife Service for formal consultation in compliance with section 7 of the Endangered Species Act and in accordance with agency policy and practices (USDA Forest Service 2017a).

Table 53 summarizes the number of federally listed, proposed or candidate species by taxonomic grouping.

Table 53. Number of federally threatened, endangered, proposed or candidate species by listing status and taxa for the Inyo National Forest

Listing Status	Mammals	Birds	Reptiles	Amphibians	Fish	Invertebrates	Plants	Total by Status
Endangered	1	0	0	2	1	0	0	4
Threatened	0	0	0	1	2	0	0	3
Candidate	0	0	0	0	0	0	1	1
Proposed	0	0	0	0	0	0	0	0
Total by Taxa	1	0	0	3	3	0	1	8

Relationship between Forest Plans and the Endangered Species Act Consultation Process

Information and science based recommendations for federally listed species is included in species recovery plans, species reviews and assessments, conservation assessments, and critical habitat designations. This information was considered in developing plan components that are designed to provide, as appropriate, ecological conditions in the plan area necessary to meet the requirements for each federally designated species.

The Forest Service has initiated formal consultation with the U.S. Fish and Wildlife Service under the provisions of section 7 of the Endangered Species Act. A biological opinion was requested regarding the selected alternative and revised forest plan. Following resolution of any objections, if any substantive changes are made to the forest plan that affect the species addressed in the biological assessment, consultation will be reinitiated to determine if an amendment to the biological opinion is needed. The Forest Service will receive and consider the final biological opinion from the U.S. Fish and Wildlife Service prior to signing a record of decision.

Forest plans are intended to be adaptive, and changes can be made for newly listed species, new critical habitat designations, or as new information becomes available. Once approved, consultation will be reinitiated on the forest plan, as needed. Consultation obligations will still apply to site-specific Forest Service actions independent of the forest plan, as required by section 7 of the Endangered Species Act and agency procedures.

Species of Conservation Concern

Species of conservation concern are defined as “a species, other than federally recognized threatened, endangered, proposed, or candidate species that is known to occur in the plan area and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species’ capability to persist over the long-term in the plan area” (36 CFR 219.9(c). Table 54 summarizes the total number of species of conservation concern for the Inyo National Forest by taxonomic grouping.

Table 54. Number of species of conservation concern by taxa

Mammals	Birds	Reptiles	Amphibians	Fish	Terrestrial invertebrates	Aquatic Invertebrates	Plants	Total
3	6	0	3	1	7	3	105	128

The 2012 Planning Rule requires that plan components provide ecological conditions necessary to maintain “a viable population” of each species of conservation concern and defines (Sec. 219.19) a viable population as one “that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments.” The concept of ecological conditions as defined in the 2012 Planning Rule includes more than vegetation composition and structure: it is designed to encompass those factors as well as others, including stressors that are relevant to species and ecological integrity. Examples of ecological conditions include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads and other structural developments, human uses, and invasive species.

As required by section 219.8(a) of the Planning Rule, plan components were developed that provide ecological conditions that promote species persistence with “sufficient distribution to be resilient and adaptable to stressors and likely future environments’ in the plan area, within the capability of the area.” The plan area is defined as National Forest System lands covered by a plan (36 CFR 219.19). Plan components include broader coarse-filter standards and guidelines that maintain or restore the structure, function, composition, and connectivity of ecosystems. In some cases, where ecosystem level plan components could not adequately address species persistence, species-specific plan components were also developed.

As with federally listed and candidate at-risk species, the extent and condition of habitat are the indicators used to determine if such ecological conditions are present to conserve species and to contribute to preventing species from becoming listed. The analysis also considers the authority of the Forest Service and the inherent capability of the plan area to provide for each species of conservation concern. We considered the range of potential plan components (desired conditions, objectives, goals, suitability of areas, standards, and guidelines) beginning with approaches that emphasize management of ecosystem properties and evaluated the characteristics of the alternatives to verify that the necessary ecological conditions were provided for at-risk species (Hayward et al. 2016). For each species of conservation concern in the plan area, we assessed whether each of the alternatives addressed known threats to the species persistence with one of four possible outcomes, or determinations:

1. The ecosystem plan components should provide the ecological conditions necessary to maintain a viable population of the [SPECIES NAME] in the plan area. No additional species-specific plan components are warranted.
2. The ecosystem plan components should provide the ecological conditions necessary to maintain a viable population of the [SPECIES NAME] in the plan area. Nonetheless, additional species-specific plan components have been provided for added clarity and/or measures of protection.
3. The ecosystem plan components may not provide the ecological conditions necessary to maintain a viable population of the [SPECIES NAME] in the plan area. Therefore, additional species-specific plan components have been provided. The combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain a viable population of the [SPECIES NAME] in the plan area.
4. It is beyond the authority of the Forest Service or not within the inherent capability of the plan area to maintain or restore the ecological conditions to maintain a viable population of the [SPECIES NAME] in the plan area. Nonetheless, the plan components should maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range.

In the case of outcomes 3 and 4 where species viability is currently uncertain, proposed plan components are designed to maintain or restore habitat toward a condition that will contribute to maintaining a viable population of the species within its range.

Relationship between
Regional Forester Sensitive Species and Species of Conservation Concern

Under the current forest plan, rare wildlife and plant species are managed according to the agency direction for sensitive species. Sensitive species are identified by the Regional Forester as plant and animal species for which population viability is a concern, where there is a significant current or predicted downward trends in population numbers or density or in habitat capability that would reduce a species' existing distribution. Sensitive species identified for the Inyo National Forest were designated by the Regional Forester following direction in the Forest Service Handbook

(FSH 2609.26, chapter 30): “the Regional Forester…must consider those species that are known, reported, or suspected to occur on, or in the immediate vicinity of National Forest System lands in the Region” (USDA Forest Service 2013i). In contrast, the 2012 Planning Rule directs that the species of conservation concern lists are specific to each national forest, and species must be known to occur in the plan area. “A species is known to occur in a plan area if, at the time of plan development, the best available scientific information indicates that a species is established or is becoming established in the plan area.”[31]

During the evaluation of species of conservation concern, over 115 terrestrial and aquatic wildlife species and over 215 plant species were considered[32], including consideration of all species on the Pacific Southwest Region’s Regional Forester’s sensitive species list for the Inyo National Forest. The Regional Forester’s sensitive species list of wildlife, fish, and invertebrate and the list of plant sensitive species on the Inyo National Forest are based on the September 9, 2013 versions of the USDA Forest Service Pacific Southwest Region Sensitive Animal and Plant Species by Forest (USDA Forest Service 2013i). Of the 27 wildlife sensitive species on the Inyo National Forest, 15 are carried forward as species of conservation concern. Of the 67 sensitive plant species on the Inyo National Forest, 46 are carried forward as species of conservation concern. In general, sensitive species were determined not to meet the established criteria as a species of conservation concern for one or more of the following reasons:

- It is a federally recognized threatened, endangered, proposed, or candidate species under the Endangered Species Act and would be considered under the other category of at-risk species.
- The species does not occur on the national forest.
- Previous occurrence records were determined to be incorrect identifications of the species and/or could not be re-located.
- Recent surveys indicated the species is more common than originally thought.
- Natureserve, California Natural Diversity Database, California Native Plant Society Rare plant inventory, or other best available scientific information or data sources indicate threats to the species were not substantial.
- There was no information about threats to the species. This was a relatively uncommon circumstance, because information about threats could be inferred from threats to the ecosystems upon which the species depend. Lack of information generally only limited species inclusion on the list if the species had not been observed for decades or more, leading to uncertainty about the condition of its specific habitat.

The specific reasons a sensitive species was determined to meet or not meet the established criteria as a species of conservation concern are provided in the species rationales found in the animal or plant rationale documents (USDA Forest Service 2018b, a) in the project record, or the biological evaluations for animals and plants (USDA Forest Service 2017b, 2017c), or the biological assessment (USDA Forest Service 2017a). For the species that did not meet the established criteria, we also provide a brief summary of our findings in table 55 and table 56.

[31] Forest Service Handbook 1909.12 § 12.52.c-d

[32] Forest Service Handbook 1909.12 § 12.52 c-d

Table 55. Summary of the rationale that a Regional Forester's animal sensitive species did not meet the established criteria as a species of conservation concern

Common Name and Scientific Name	Rationale For Not Meeting Criteria
Northern goshawk *(Accipiter gentilis)*	There are 38 known northern goshawk nest sites distributed across the forest. Territories remain well-distributed in the plan area despite the past widespread changes in the amount and distribution of mature forest habitat. Goshawks use multiple vegetation types. The increase in drought and bark beetle related tree mortality is much less than west-side forests, however impacts to goshawk are unknown at this time. Climate change and potential drought related effects will likely exert pressure on the key ecological conditions for this species, but the long-term effects are unknown. At this time, the best available scientific information does not indicate substantial concern about the species' capability to persist over the long-term in the plan area.
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis)*	Federally listed as a threatened species. No known occurrence in the plan area.
Pallid bat (*Antrozous pallidus)*	There are few studies on bat detections on the Inyo National Forest but the species has been documented in the Inyo Mountains and the White Mountains and was detected in the McNally fire area post-fire. Many records occur in the Owens Valley, including museum records, but mostly outside of the plan area. The greatest threats to the persistence of pallid bats are those most closely associated with the Central Valley and urban areas, not National Forest System lands. Since they use a wide diversity of roosting structures, threats to tree roosting sites are not considered a limiting factor within the plan area. At this time, the best available scientific information does not indicate substantial concern about the species' capability to persist over the long-term in the plan area.
Townsend's big-eared bat *(Corynorhinus townsendii townsendii)*	The primary roosting habitat is in caves and mines. There is one known maternity colony on the forest and habitat for maternal roosts may be naturally limited and suboptimal due to the high elevations on the forest. There have been no documented disruptions or reductions to maternity colonies. Roosting in conifer snags is less likely as the majority of the mixed conifer and Jeffrey pine types have minimal overlap with known Townsend's bat detection sites. Bat usage at monitored roosting sites appears to at least be stable across the forest and adjacent BLM lands. At this time, the best available scientific information does not indicate substantial concern about the species' capability to persist over the long-term in the plan area.
Fringed myotis *(Myotis thysanodes)*	The Inyo is within the species' range and potential habitat exists, however, no contemporary occurrences were detected during comprehensive bat surveys in the White-Inyo Mountain Range and there are no known documented maternity colonies on the forest. It is unknown how widespread this species is within suitable habitat, if at all, on the Inyo National Forest. The biggest threat on the planning unit appears to be loss of habitat through fire and climate related disturbance events, though it is difficult to predict what effect this would have on potential habitat in the long term. Based on the consideration of factors evaluated, there is currently insufficient information to demonstrate substantial concern for long-term persistence in the plan area.

Common Name and Scientific Name	Rationale For Not Meeting Criteria
Pygmy rabbit *(Brachylagus idahoensis)*	The pygmy rabbit's range on the forest is primarily in Nevada but does include a slight portion of California at the northeast corner of the Mono Lake Ranger District border with Nevada. There is no available scientific information that indicates populations are in decline on the forest. There is a potential loss of habitat by wildfire but the sagebrush habitat occurs on sandy soils which, based on knowledge of local fire behavior, does not tend to result in high intensity burns or loss of large sections of intact sagebrush. At this time, the best available scientific information does not indicate substantial concern about the species' capability to persist over the long-term in the plan area.
Wolverine (*Gulo gulo)*	Federally listed as a proposed threatened species. No contemporary verified or documented occurrences in the plan area.
Sierra Nevada Red Fox (*Vulpes vulpes necátor*)	Federally identified as a candidate species. No known occurrence in the plan area.
Yosemite toad (*Anaxyrus canorus)*	Federally listed as Threatened. Analyzed as at-risk species
Mountain yellow-legged frog (*Rana muscosa)*	Federally listed as Endangered. Analyzed as at-risk species
Sierra Nevada yellow-legged frog (*Rana sierrae)*	Federally listed as Endangered. Analyzed as at-risk species
Panamint alligator lizard (*Elgaria panamintina)*	The best available scientific information suggests that the number of populations is stable and likely greater than what is currently known, but specific trends are unknown. Change in water surface flow and riparian integrity are potential threats to persistence, but these threats are minimal where the species exists. Habitat within the plan area is at low risk of loss or degradation due to anthropogenic activities; however, climate change could influence daily temperatures, precipitation amounts and timing and type of precipitation. At this time, the best available scientific information does not indicate substantial concern about the species' capability to persist over the long-term in the plan area.

Table 56. Summary of the rationale that a Regional Forester's plant sensitive species did not meet the established criteria as a species of conservation concern

Species	Rationale For Not Meeting Criteria
Abronia nana ssp. *covillei*	There are many populations and individuals known from a relatively large area on the Inyo National Forest, and though they are constrained to limestone substrates, they are not highly specific to elevation, and thus occupy major vegetation zones from sagebrush to pinyon-juniper, mountain mahogany, and bristlecone pine-limber pine. The threats of mining and grazing do not appear to be substantial because the plant is so widely distributed that impacts are unlikely to affect more than a small proportion of individuals on the Forest. Finally, monitoring and surveys have not indicated a downward trend for this species. The best available scientific information does not indicate substantial concern about the species' capability to persist over the long term in the plan area.
Boechera evadens	*Boechera evadens* grows on rock outcrops around 2600 m elevation in the southern High Sierra Nevada. None of the four CNDDB records is on the forest. There is also evidence that the species hybridizes with *B. lemmonii* and possibly other *Boechera* species, making identity of populations uncertain. The occurrence of this species in the plan area is not documented in the best available scientific information

Species	Rationale For Not Meeting Criteria
Botrychium lunaria	There is insufficient information about its status on the Inyo National Forest. A single available record is based on a 35-year old collection that appears to be from a private parcel where no follow-up surveys have been conducted. In addition, taxonomic research for this species is strongly needed.
Botrychium paradoxum	No known occurrence in the plan area.
Botrychium tunux	No known occurrence in the plan area.
Botrychium yaaxudakeit	No known occurrence in the plan area.
Cladium californicum	No known occurrence in the plan area.
Cryptantha incana	This species occurs on both the Inyo and Sequoia National Forests. Numerous collections from the plan area indicate this species is much more common than previously thought, and that several occurrences could be added to CNDDB. In addition, no threats have been documented. Natureserve indicates that ranks were assigned based on the very small number of occurrences, and that ranks have not been reviewed since 2005, and, thus, may need revision. There is no substantial concern about the species' capability to persist over the long term in the plan area.
Draba asterophora var. *asterophora*	No known occurrence in the plan area.
Draba cruciata	No known occurrence in the plan area.
Draba incrassata	There are no verified occurrences of this species in the plan area. A single collection was made more than 50 years ago, potentially outside the Forest boundary, with no other information available for the species in the plan area.
Erigeron aequifolius	There is little occurrence information for this species in the plan area. There is no substantial concern about the species' capability to persist over the long term in the plan area because no threats are known.
Erigeron multiceps	There is a single known occurrence in the plan area, occurring on a steep, rugged slope with difficult access. There are no known threats. There is no substantial concern about the species' capability to persist over the long term in the plan area.
Hulsea vestita spp. inyoensis	Reported occurrences have not been relocated in 40+ years; there is insufficient information positively documenting its current occurrence in the plan area
Lupinus lepidus var. *culbertsonii*	No collections from the plan area could be verified to be this variety of *L. lepidus*, and no occurrences have been relocated in over 30 years. There is insufficient information about the species, best available science does not support the occurrence of the species in the plan area.
Meesia uliginosa	No known occurrence in the plan area.
Peltigera gowardii	There is no substantial concern about the capability of *Peltigera gowardii* to persist over the long term in the plan area because no threats were identified for this species in the plan area. In addition, it is likely that additional field surveys by qualified personnel would identify additional occurrences in the plan area
Phacelia novenmillensis	No known occurrence in the plan area.
Pinus albicaulis	Federally identified as Candidate species; analyzed as at-risk species
Senecio pattersonensis	There is a single known occurrence in the plan area, occurring on a steep, rugged slope with difficult access. There are no known threats. There is no substantial concern about the species' capability to persist over the long term in the plan area.

For each sensitive species that is not species of conservation concern, the biological evaluations for wildlife (USDA Forest Service 2017b) and for plants (USDA Forest Service 2017c) provide an analysis of the consequences for alternative B-modified. The effects analyses in the biological evaluations are completed by examining occurrence and habitat information for each sensitive species, and identifying the potential effects of the revised forest plan and plan components to ecosystem types (habitat) in which species occur and on the species or groups of species. Threats to species or groups of species or to habitats and habitat conditions were identified as indicators because they are measures to maintain viable populations.

While some sensitive species are not carried forward as species of conservation concern, forest plan direction is written broadly enough to provide ecological conditions that support ecosystem integrity and ecosystem diversity that should support their persistence in the plan area. For some species of conservation concern, the plan revision alternatives provide direction to manage for “special habitats” that surround the individual species occurrence locations in order to provide the necessary ecological conditions that allow for their persistence. This might benefit some sensitive species that occur in association with other species of conservation concern. For the northern goshawk, although not a species of conservation concern, a forestwide guideline for Animal and Plant Species provides that known nest, roost, or den trees used by raptors should not be purposefully removed except for hazard tress or unless otherwise required by state or federal regulations. This was expanded from applying only to species of conservation concern to also apply to raptors and it was expanded to also protect surrounding trees that provide beneficial thermal or predatory protection. For the bat species that are not species of conservation concern, plan guidance provides protection for bat hibernacula or maternity colonies that may be adversely affected by recreational, management, or other activities by considering either installing bat gates at the entrances of caves and mines or restricting access by other means. In addition, a forestwide desired condition applies to habitats and the ecological conditions and processes that would guide all projects to provide for sustainable populations of native species.

Adaptive procedures under the 2012 Planning Rule provide for continued consideration of species included on the species of conservation concern list, including revisions of the list to add or remove species if necessary. Under the plan revision alternatives, if new information indicates that an additional species meets the criteria for being added as a species of conservation concern, the responsible official for the national forest where the species occurs may recommend the addition to the Regional Forester for the Pacific Southwest Region of the Forest Service. If the Regional Forester approves the change, the responsible official then determines if a change in forest plan direction is needed. Likewise, new scientific information regarding an existing species of conservation concern may lead to their removal from the list if there is no longer a substantial concern for its persistence in the plan area; or new information may lead to a need to change the forest plan to add, remove, or change plan components. Since the process of identifying and managing species of conservation concern is adaptive and can be changed, longer term environmental consequences to former sensitive species is not expected. If ecological conditions change, new scientific information about species becomes available, or new or emerging threats are recognized, former sensitive species can be re-evaluated to determine if they should become species of conservation concern.

Migratory Birds

Migratory birds are birds that have a seasonal and somewhat predictable pattern of movement. For the sake of forest planning, migratory birds are defined as all species covered by the Migratory Bird Treaty Act. Generally, this includes all native birds in the United States, except those non-migratory species such as quail and turkey that are managed by the States. The Forest Service implements its migratory bird conservation responsibilities under the Act as described in its respective memorandum of understanding developed with the U.S. Fish and Wildlife Service in accordance with Executive Order 13186. The current memorandum of understanding between the Forest Service and the U.S. Fish and Wildlife Service to promote the conservation of migratory birds was signed in 2008 and extends to December 31, 2017. In 2016, the Forest Service and U.S. Fish and Wildlife Service agreed to an extension of the memorandum of understanding and currently work is underway on an additional extension. The intent of the memorandum of understanding is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the U.S. Fish and Wildlife Service as well as other Federal, State, tribal and local governments. Within the National Forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities. The Forest Service agreed to address the conservation of migratory bird habitat and populations when revising forest plans by considering the list of Birds of Conservation Concern published by the U.S. Fish and Wildlife Service (United States Department of Interior 2008). This list was considered when determining the species of conservation concern for the Inyo National Forest. Migratory birds that met the criteria of species of conservation concern for the Inyo National Forest include bald eagle, California spotted owl, bi-state greater sage-grouse, and willow flycatcher. These species are evaluated in this document and in the document “Rationales for Animal Species Considered for Species of Conservation Concern, Inyo National Forest” (USDA Forest Service 2018a).

In January of 2000, the Forest Service released a Landbird Strategic Plan (USDA Forest Service 2000). The primary purpose of the strategic plan was to provide very general guidance for the agency’s landbird conservation program. Among the suggested actions was the incorporation of landbird management into forest plans. Recent reports produced by the North American Bird Conservation Initiative and known as “State of the Birds” reports have been issued by several organizations and Federal agencies to summarize the general condition of birds across the United States. These “State of the Birds” reports use the latest bird monitoring and scientific data to assess the status and health of all U.S. bird species and promote birds as indicators of overall environmental health and human well-being. These reports paint a picture of declines in multiple species across a variety of habitats. Climate change was one of the contributing factors to these declines, and is likely to continue impacting birds into the future. As the climate warms, breeding seasons and migrations are being altered and may become out of sync with prey abundance and availability. This reinforces the need to have resilient and diverse habitat that can help species adapt to climate change. The 2011 report focused on public lands and waters and stated that “[n]atural processes must be restored to ensure functional and resilient ecosystems through management actions such as control of nonnative species and diseases, prescribed cuts and burns to reinvigorate forests and grasslands, and water delivery and management to sustain wetlands” (North American Bird Conservation Initiative 2011). For arid lands, the report identified the need to focus on “control of invasive plant species; keeping fire and other forms of disturbance within normal limits; promoting natural patterns of plant succession; and helping birds and other biodiversity adapt in the face of climate and land-use change” (*Ibid.*). For western forests, the report identified the need to focus on the “loss of pines, especially pinyon and whitebark pine, due to spread of white pine blister rust, mountain pine bark beetle, and other invasive pests” and “restoration of natural fire regimes” (*Ibid.*). The coordinating group, Partners in Flight, also produced a North American Landbird Conservation Plan in 2004 (Rich et al. 2004) and a revision of the plan in 2016 (Rosenberg et al. 2016), and keeps a Strategic Action Plan updated (current version 1.2). These plans promote the conservation of migratory and other birds and have two main components: (1) helping bird species at risk, and (2) keeping common birds common.

The Inyo forest plan revision addressed this by considering the habitat upon which migratory birds depend during the development of plan components for the plan revision alternatives. Such considerations are already in place under alternative A. Migratory birds are ubiquitous and use virtually all habitat types across a range of elevations. Therefore, restoration of many vegetation types at various elevations would benefit habitat for migratory bird species, especially in cases where restoration focuses on moving the vegetation toward the natural range of variation, improving resilience to wildfire and changing climate conditions, protecting and restoring riparian and watershed conditions, and controlling or eradicating invasive species (see discussion in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections).

In the plan revision alternatives, plan components help identify and guide projects to address threats and other risks to ecological conditions important for at-risk species, including migratory birds that are species of conservation concern. Some plan components are broader and apply to all native species that occur within the plan area. In general, forest plan components and plan content were designed to meet the needs of migratory birds and other species by addressing high priority habitats and their associated vegetation type or aquatic system where they depart from desired ecological conditions. These components include guidance on restoration approaches that reduce and limit short-term impacts while focusing on improving landscape resilience. Examples of emphasis habitats include systems that are highly altered such as some meadows where water tables have been lowered or vegetation reduced, altered montane forests and riparian areas that lack resiliency to wildfire under changing climatic conditions, and sagebrush ecosystems that have been impacted by conifer encroachment and invasive annual grasses.

Common migratory birds, by definition are expected to persist on the landscape because the plans strive to retain ecosystem diversity to provide for a range of habitats and provide the ecological conditions expected for the plan area to provide for ecological integrity. Since the forest plan is a programmatic document, although the different alternatives emphasize different approaches to moving towards desired conditions and would have different rates of movement over the life of the forest plan, they all include plan components to provide for the essential elements of migratory bird habitat when later projects are proposed and projects would continue to assess site-specific effects to migratory birds. Habitat for migratory birds is anticipated to persist under all alternatives.

At-risk Terrestrial Species

Background

This section evaluates and discloses the potential environmental consequences of the five forest plan alternatives on at-risk terrestrial wildlife species and habitat. This analysis evaluates the effectiveness of the alternatives to provide direction to create the ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of species of conservation concern within the plan area.

The need for plan revisions is guided by three primary topics, including “Ecological Integrity” which addresses the need to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought, and climate impacts; restore wildlife and plant habitat and diversity; and reduce the risk of wildfire impacts to species and wildlife habitat. An issue related to at-risk terrestrial species includes the concern that the perceived accelerated pace and scale of potential management activities to restore resilience may not provide adequate habitat for wildlife species that use forests with large trees and dense canopy cover. Conversely, a second issue is that overemphasizing wildlife habitat needs overshadows the resilience and sustainability need of the forest itself. There is a concern that wildfires that could be managed to meet resource objectives will continue to be suppressed instead. There is also a concern that aquatic and riparian systems that provide habitat for many terrestrial wildlife species are under increasing stress and in need of restoration in order to increase their resilience to the effects of climate change and drought. The five alternatives present a range of approaches that address the revision topics and issues, including the issues related to at-risk terrestrial wildlife species and habitat.

Analysis and Methods

This analysis uses a complementary ecosystem and species-specific approach to assess the alternatives' potential for providing the habitat characteristics to support wildlife diversity and the persistence of native species in each plan area. This is sometimes referred to as a coarse-filter and fine-filter approach, where the coarse-filter assumes that wildlife diversity is broadly dependent upon the integrity of the function, composition, and structure of the forest's terrestrial, riparian, and aquatic ecosystems. This analysis compares the current abundance and condition of various habitats with ecological reference conditions (natural range of variation) based on the dynamic nature of ecosystems, recognizing they are not static (Landres, Morgan, and Swanson 1999a). It recognizes that disturbances or processes like fire, flooding, insects, and disease, and responses to those disturbances, are part of natural ecosystem processes. However, because integrity of whole ecosystems does not necessarily address all species' needs, additional species-specific or fine-filter analyses were conducted to ensure that persistence is provided for at-risk wildlife species.

As described in the "Agents of Change" section, a disruption of natural processes (such as the legacy of fire suppression) can impact diversity and lead to a departure from the natural range of variation. Maintaining or mimicking natural processes and naturally occurring structural diversity; promoting natural patterns and connectivity; restoring ecosystems, communities, and species; and protecting the ecological characteristics required by at-risk species are all means to maintain biodiversity in an ecosystem. The coarse-filter and fine-filter approaches used in this analysis help to disclose how well each alternative addresses these needs.

Overall, we used a qualitative approach for this analysis. It is based on scientific literature about species, their habitat, and effects of management. The analysis of habitat is based largely on that described in the "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" sections (coarse filter components). The evaluation of environmental consequences to habitat that supports species persistence is framed as a risk assessment in terms of alternative effectiveness. However, there is a level of uncertainty about the possible effects of forest management and activities on habitat that supports species persistence because of gaps in knowledge about the complex interaction between species and their habitats (Holthausen 2002) and how some species respond to varying degrees of habitat alteration.

The analysis area includes all National Forest System lands within the Inyo National Forest. In some cases, the best available scientific information for at-risk species' ecological relationships originated outside the analysis area. However, indicator measures and threat information from within the analysis area were used in making conclusions. Because there is more detailed and site-specific biological and threat information for federally recognized threatened, endangered, and candidate species than for species of conservation concern, and because the Forest Service

Handbook outlines different intents when identifying plan components necessary to provide for the two groups of species, the level of analysis is more general for most species of conservation concern.

Indicators and Measures

Federally Listed Species

The analysis evaluates two primary aspects for federally listed species. First, the adequacy of plan direction in each alternative to protect, maintain, and restore habitat elements identified for species and primary constituent elements of designated critical habitat. Second, the adequacy of plan direction to avoid, minimize, or mitigate potential adverse effects to federally listed species and candidate species focusing on the relevant threats on the Inyo National Forest to individuals within occupied and critical habitat. The analysis also considers the authority of the Forest Service and the inherent capability of the plan area to provide for federally listed at-risk species. An analysis for the selected alternative is documented in detail in the biological assessment submitted to the U.S. Fish and Wildlife Service and available in the project record.

Species of Conservation Concern

The key indicators for the terrestrial species analysis are trends in habitat quantity and habitat condition considering a landscape scale. Primary habitat associations and associated threats are described for each at-risk species. Habitat quantity is evaluated by the potential trend in relative amount and distribution of habitat types in the plan areas over the next 15 years. Habitat condition is evaluated by the potential trend in resiliency and ability of habitats to be adaptable to large-scale disturbances (such as wildfire, insect outbreaks, and drought).

When we examined habitat quantity, we determined that there are no expected changes in the overall quantity of habitat as a result of the forest plan revision under any alternative during the life of the forest plan. In other words, the forest plan alternatives do not envision different amounts of a particular habitat as part of the desired condition, but we do recognize that different alternatives might achieve desired conditions at different rates. We also recognize that habitat conditions might be affected in the short-term by restoration activities when projects are developed and implemented that varies by alternative because different methods are preferred or slightly different priorities would established.

These indicators were selected because they provide a reasonable assessment of ecological conditions needed to support the persistence of species of conservation concern and because relative differences among alternatives could be readily compared. We made qualitative, rather than quantitative comparisons. The amount of habitat provides a relative measure of habitat condition and extent to maintain species persistence and is also an appropriate measure for a programmatic-level analysis. The condition of habitat is used as an indicator only when it can be estimated adequately at the programmatic-level, such as assessing not only the amount of impact from wildfire but also the type of fire and the resulting effects on habitat quality.

Management directions that may alleviate or exacerbate threats to habitat are evaluated at a programmatic level. The forest plan does not authorize site-specific projects or activities; therefore there are no direct effects from adopting the forest plan. The direct and indirect site-specific effects will be analyzed when future projects are proposed. Although potential short-term consequences may be described where appropriate from implementing the programmatic approach, this evaluation focused on longer term indirect and cumulative effects that may occur over the 15-year life of the forest plan.

Much of the analysis is based upon the premise that the natural range of variation provides important background information for evaluating ecological integrity and sustainability (Wiens et al. 2012). The natural range of variation was used in development of plan direction (desired conditions) and the selection of indicators and measures for the analysis because the condition and quantity of habitat available to a species helps predict the potential for species distribution and abundance within that habitat. Also important in the analysis of ecological integrity and sustainability of vegetation are consideration of climate and associated fire trends that may be creating a combination of conditions that are outside of the natural range of variation (Safford et al. 2012, Millar and Stephenson 2015).

Coarse-filter plan components (largely centered on desired conditions within the natural range of variation) are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area including at-risk species.[33] The coarse-filter approach is considered the primary context for evaluating at-risk species. Where coarse-filter components would not provide sufficient conditions for one or more at-risk species, fine-filter (species-specific) plan components, including standards and guidelines, were incorporated.

The analysis involves:

- Identifying habitat associations of and threats to at-risk species,
- Reviewing plan components that have potential to influence habitat conditions, thereby influencing the ecological conditions that would support species persistence,
- Evaluating the proposed magnitude of change in the management approach by alternative and potential consequences from the management approach, and
- Revising plan components (including incorporating fine-filter components where necessary) to provide needed ecological conditions

Sources of information include:

- Peer-reviewed published literature, general technical reports and other reports by the Forest Service and other agencies;
- Various databases (such as the California Natural Diversity Database, Forest Service Natural Resource Information System Wildlife database, and eBird[34]);
- Personal communications with researchers, species experts, and California Department of Fish and Wildlife staff;
- U.S. Fish and Wildlife recovery plans for threatened and endangered species;
- Final Inyo National Forest Assessment (USDA Forest Service 2013a);
- Science Synthesis to Support Sociological Resilience in the Sierra Nevada and Southern Cascade Range (Long, Quinn-Davidson, and Skinner 2014c);
- Resource reports for terrestrial ecology, fire ecology, and aquatic ecosystems; and
- Natural Range of Variation Assessment reports for the various habitats in the Sierra Nevada as prepared by the Forest Service (Gross and Coppoletta 2013, Estes 2013b, Meyer 2013a, b, Safford et al. 2013a, Merriam et al. 2013, Sawyer 2013b, Slaton and Stone 2015a, b).

[33] Forest Service Handbook 1909.12

[34] eBird is a citizen science site for reporting bird observations: http://ebird.org/content/ebird/)

Analysis Area

In general, the analysis area for indirect effects includes all lands managed by the Inyo National Forest; however, for the purposes of this document it may include areas outside the national forest boundary. In some cases National Forest System lands may provide all or a high percentage of the habitat for a given species; however, in most instances, wildlife generally move from area to area and habitats on National Forest System lands may be important to the overall persistence of the species within its range. Cumulative effects analyses generally include lands within other ownerships immediately adjacent to the national forest, including adjacent national parks (Sequoia and Kings Canyon and Death Valley), national monuments (Devil's Postpile), land managed by the Bureau of Land Management (particularly along Highway 395), and comparatively smaller sections of State, county, and privately owned lands. For some wide-ranging species, the analysis area was a little larger and included an evaluation of connectivity between larger areas of habitat. For species with migratory or travel routes that extend far beyond the Sierra Nevada, management direction under alternatives B, B-modified, C, and D would only influence habitat persistence (both quantity and condition) within the national forest plan areas, but actions that occur outside of National Forest System lands is beyond the authority of the Forest Service to influence.

Assumptions

- If a species is associated with a particular habitat, then the condition, amount, and distribution of those habitat elements available to the species on the landscape help to predict its distribution and abundance within that habitat.
- Habitat abundance and distribution similar to that which supported associated species during conditions as a consequence of evolutionary time, will likely contribute to their maintenance in the future (Haufler 1999). Therefore, habitat abundance, distribution, and condition similar to that within the natural range of variation for the habitats will likely contribute to species maintenance in the future. (See also the "Terrestrial Vegetation Ecology" section).
- In general, the further a habitat is departed from desired conditions (natural range of variation), the greater the risk to persistence of associated species. Conversely, the closer a habitat is to desired conditions, the lower the risk to persistence of associated species Therefore, comparing the degree to which the alternatives trend conditions toward desired conditions provides a comparison of each alternative's effectiveness at providing habitats that contribute to maintaining species persistence.
- For the purposes of analysis, we are assuming the plan alternatives will be implemented as described and objectives will be realized over the life of the plan.

Species Evaluated

Federally Listed Terrestrial Species

Table 57 lists the federally listed terrestrial species and status of critical habitat considered in the analysis. Table 58 lists species that were identified in initial species lists from the U.S. Fish and Wildlife Service but were determined to not occur within the Inyo National Forest and are not considered in detail in this analysis. Further information regarding these species can be found in the biological assessment in the project record.

Table 57. Federally designated terrestrial threatened, endangered, proposed, and candidate species and critical habitat that occur in the Inyo National Forest plan area

Common Name*	Scientific Name	Status	Critical Habitat
Sierra Nevada bighorn sheep	*Ovis canadensis sierra*	Endangered	Final Designated

* DPS = Distinct Population Segment

Table 58. Federally designated terrestrial threatened, endangered, proposed, and candidate species and critical habitat that do not occur in the Inyo National Forest plan area and are not analyzed in detail

Common Name	Scientific Name	Status*	Critical Habitat
North American wolverine	*Gulo gulo luscus*	Proposed Threatened	Not applicable
California condor	*Gymnogyps californianus*	Endangered	Final Designated
Least Bell's vireo	*Vireo bellii pusillus*	Endangered	Final Designated
Yellow-billed cuckoo, western U.S. DPS	*Coccyzus americanus*	Threatened	Final Designated
Western snowy plover, Pacific Coast DPS	*Charadrius alexandrines nivosus*	Threatened	Final Designated

* E = Endangered; T = threatened; PT = Proposed Threatened

Terrestrial Wildlife Species of Conservation Concern

Table 59 lists the terrestrial wildlife species of conservation concern separated by the taxa or type of animal, such as mammals, birds, and types of invertebrates.

Table 59. Terrestrial wildlife species of conservation concern for the Inyo National Forest

Taxa (Type)	Common Name	Scientific Name
Mammal	Nelson desert bighorn sheep	*Ovis canadensis nelsoni*
Mammal	Pacific fisher	*Pekania pennanti*
Mammal	Sierra marten	*Martes caurina sierra*
Bird	Bald eagle	*Haliaeetus leucocephalus*
Bird	Bi-state greater sage-grouse	*Centrocercus urophasianus*
Bird	California spotted owl	*Strix occidentalis occidentalis*
Bird	Great gray owl	*Strix nebulosa*
Bird	Mount Pinos sooty grouse	*Dendragapus fuliginosus howardi*
Bird	Willow flycatcher	*Empidonax trailii brewsteri* and *E.t. adastus*
Terrestrial invertebrate	Sierra sulphur	*Colias behrii*
Terrestrial invertebrate	Square dotted blue	*Euphilotes battoides mazourka*
Terrestrial invertebrate	Mono Lake checkerspot	*Euphydryas editha monoensis*
Terrestrial invertebrate	Boisduval’s blue	*Plebejus icarioides inyo*
Terrestrial invertebrate	San Emigdio blue	*Plebulina emigdionis*
Terrestrial invertebrate	Apache fritillary	*Speyeria nokomis apacheana*
Terrestrial invertebrate	A cave obligate pseudoscorpian	*Tuberochernes aalbui*

Affected Environment

The diverse landscape of the Inyo National Forest includes a variety of topographic, geologic, and soil conditions, and is influenced by a wide range of precipitation and temperature regimes shaped by the unique conditions of being on the east side of the Sierra Nevada crest and at the edge of the Great Basin. The east side of the Sierra Nevada, Glass Mountains, White Mountains and Inyo Mountains are the major mountain ranges and influence the distribution of major ecosystems across the forest.

Many of the terrestrial ecosystems that support wildlife species in this portion of the Sierra Nevada are outside the range of natural variation due to a variety of past and current land use practices and changing climate conditions. Past activities like water diversion, livestock grazing, mining, various kinds of timber harvest, and fire suppression have contributed to these vegetation types changing away from their natural states. Changing climate conditions like drought and warming temperatures are also fostering increasingly stressed vegetation conditions that are vulnerable to high-severity effects of large and frequent wildfires, and pest and insect outbreaks, among other disturbances.

As described in the "Fire Trends" and "Terrestrial Vegetation Ecology" sections, large fires with high-severity effects are occurring more frequently in the Sierra Nevada, particularly in the dense forested stands in montane vegetation. While this trend is greatest on the west side of the Sierra Nevada, larger and more severe wildfires are also occurring on the Inyo National Forest. Although specific effects are generally not known, these fires are having adverse consequences on many species associated with forested landscapes. For example, fires with high-severity effects can completely remove nesting and denning trees, roost trees, structurally complex understories that support prey, and denning and cover structures. In addition to fire, large trees and groups of trees are dying from widespread insect outbreaks and the spread of diseases and pathogens. Drought stress is not only weakening these trees and making them more vulnerable to insects, diseases, and pathogens, but it is also causing many trees to die. Tree densities in the forests of the Sierra Nevada and Great Basin ranges, as well as prolonged drought conditions pose a significant and growing threat of levels of tree mortality outside of the natural range of variation to montane forest habitat and the species associated with them.

Terrestrial ecosystems of the Sierra Nevada are expected to continue to be dramatically influenced by changes in climate in the coming decades (Mallek, Safford, and Sawyer 2012, Safford et al. 2012). Consequently, the future range of variation in climate exposure for these ecosystems will almost certainly exceed the natural range of variation. Changing climate conditions have been influencing, and are projected to continue to have effects on terrestrial wildlife species. In California, a total of 128 (36 percent) of 358 bird species are considered vulnerable to climate change, including at-risk species like greater sage-grouse and great gray owl (Gardali et al. 2012).

Climate change has also been correlated with latitudinal and altitudinal range boundary shifts in some species (Parmesan 2006, Moritz et al. 2008, Crimmins et al. 2011) as well as phenological shifts (changes in timing of migration and blooming) for a variety of plants and animals (Parmesan and Yohe 2003, Root et al. 2003). Uphill and higher elevation range shifts in response to historical warming have been well documented (Lawler, Safford, and Girvetz 2012). For example, in Yosemite National Park, one study found four species expanded their upper elevational range limit, nine species contracted their lower range limit, and changes occurred in community composition at mid- and high-elevations (Moritz et al. 2008). Some of these shifts in distribution are associated with changes in precipitation and temperature (Tingley et al. 2009). Upward shifts were found in elevation range of some butterfly species in the Sierra Nevada (Forister et al. 2010).

Despite general trends of upslope or northward movement of a number of plant and animal species, many species are idiosyncratic with respect to shifts in geographic distribution with climate change. For example, although the regeneration of several tree species appear to be shifting towards colder climates, this trend is often masked by other factors such as disturbance and land use history, precipitation patterns, biotic interactions, and the presence of local climate refugia (Monleon and Lintz 2015). These non-climate factors often result in spatially-variable distributions of tree regeneration, including localized hotspots that are more closely linked to natural and anthropogenic disturbances than climate (Serra-Diaz et al. 2016). Moreover, most tree species in California show little evidence of shifting towards higher latitudes or elevations due to the particular responses of individual species to climate and non-climate factors (such as fire history). This individualistic pattern to changes in climate is evident in other taxa from the Sierra Nevada and California, including small mammals (Moritz et al. 2008), birds (Tingley et al. 2009), and plants (Rapacciuolo et al. 2014). The individual nature of species' responses to climate and nonclimate factors makes it difficult to predict future changes in plant and animal distributions with climate change. Species distribution models have better accuracy when considering the essential features of species' climate vulnerability, including climate exposure, sensitivity, and adaptive capacity (Rapacciuolo et al. 2014).

At the ecosystem level, community composition will change as the ranges of species shift. It appears that related species and species in the same ecological community may respond differently to changing environmental variables and these disparate responses may result in the breaking up of existing ecological communities and formation of novel communities (Root et al. 2003, Moritz et al. 2008, Stralberg et al. 2009). This reshuffling of species in communities can present species with new challenges such as changes in predator and prey relationships, parasitism, and competition.

Terrestrial Wildlife Habitat

Subalpine and Alpine Vegetation Zone (Subalpine Woodlands and Forests, Alpine Vegetation)

Above the upper montane zone are the subalpine and alpine zones. The subalpine landscapes consist of a mosaic of subalpine forests and woodlands, extensive rock outcrops, scrub vegetation, meadows, and riparian corridors (Fites-Kaufman et al. 2007). Since alpine environments are found at the extreme end of the temperature gradient in the Sierra Nevada, the life forms that are narrowly adapted to those conditions essentially have nowhere to go as their environment changes, making them among the most vulnerable to climate change (Sydoriak et al. 2013a). These alpine ecosystems are more threatened due to rapid climate change (Loarie et al. 2008).

Coniferous forests in the subalpine zone in California typically support fewer species of birds and mammals than any other major forest type in the state (Verner and Purcell 1988). The reasons, though not clearly established, probably involve some combination of climate, short growing season, lower primary productivity, moisture stress, and lower production of insects and other invertebrates that provide food resources for many vertebrates (Verner and Purcell 1988). Additionally, some species of conservation concern butterfly populations have been located in high-elevation dry and wet meadows and rocky habitat. This zone also includes the areas of talus and rock outcrops that support a variety of at-risk species. For example, Sierra Nevada and Nelson desert bighorn sheep use the upper montane, alpine, and subalpine habitats of the plan area, particularly rugged, rocky areas. Sierra marten and Mt. Pinos sooty grouse use some portions of the subalpine zone where dense patches of forest are interspersed with meadows and riparian areas.

Old forests are located across various elevations and ecosystems. Although old forests tend to contain old and usually large trees, tree size varies based on species and site productivity (see "Terrestrial Ecosystem Processes and Functions," "Special Habitats" subsection). The density, size and arrangement of individual trees also varies by ecosystem type with higher elevations having a more open and scattered arrangement. Old forests at lower elevations tend to contain larger trees in a wide variety of densities and canopy covers. Old forests often contain large snags and logs in addition to large live trees. The densities of all of these old forest components varied widely in the past. Much of the montane mixed conifer and pine forests that contain large, old trees are more uniformly dense, with high tree cover, than they were in the past (Safford 2013, Stephens et al. 2015, Collins et al. 2015). There are increased rates of old growth trees dying from competition with younger trees for water, climate change that influences carbon balances and growth reserves, insect-related mortality, and increased high-intensity fire. Pacific fisher and Sierra marten are associated with old forests.

For this analysis, complex early seral habitat is defined as the stage of forest development that follows a significant mortality event in a mature forest (see "Terrestrial Ecosystems Processes and Functions," "Special Habitats" subsection). Typical major disturbance events in the Sierra Nevada currently include large wildfires with high-severity effects and wide-scale insect outbreaks. The death of many overstory trees creates openings that allow other plants and tree seedlings to reoccupy the site. The complex early seral habitat is often characterized by high densities of snags, the development of shrub cover and other native vegetation, downed wood and natural conifer regeneration. This transitional seral stage provides important habitat for a variety of birds and small mammals. This habitat can also be important for woodpeckers and cavity-nesting birds that benefit from the increase in snag habitat and food resources associated with dead and dying trees. With the change of vegetation from the natural range of variation, the size and distribution of complex early seral habitat in both location and timing has changed with large fires creating very large areas of high-severity fire.

Sierra Nevada Montane Zone (Dry Mixed Conifer Forests, Jeffrey Pine Forests, Red Fir Forests, and Lodgepole Pine Forests)

The eastside Jeffrey pine and dry mixed conifer forest-dominated montane zone occurs on the Kern Plateau and also on the eastern escarpment. Here, the montane zone contains dry mixed-conifer forests with varied mixtures of Jeffrey pine, white fir, and sometimes lodgepole pine and at higher elevations some red fir (Safford 2013, Fites-Kaufman et al. 2007, Safford and Stevens 2017). The mixed conifer forests in this zone support a variety of wildlife species including Pacific fisher, Sierra marten, California spotted owl, great gray owl, and Mt. Pinos sooty grouse.

Overall, vegetation and fire regimes of this zone are outside the natural range of variation. Fire exclusion and past timber harvest has resulted in higher forest densities, increased and more uniform canopy cover of trees, greater small and medium tree density, and lower large tree density than desired (see "Terrestrial Vegetation Ecology" section) (Safford and Stevens 2017). Due to these factors, there is less heterogeneity within stands of trees, which reduces habitat diversity and habitat quality for species such as California spotted owl (Stephens et al. 2016). In addition to trees killed from fires, the amount of large trees dying has doubled in the last two to three decades across the western U.S. (Van Mantgem et al. 2009). Trees are stressed by a variety of factors such as drought, air pollutants, insects, pathogens, competition, and climate change. Within most of this zone, wildfires are burning much less frequently than historic conditions (Safford and Van de Water 2014), but evidence is strong that wildfires in this zone are on average larger and more severe than they were pre-European settlement (Safford 2013, Collins and Skinner 2014c). Overall, resilience of these forests to drought, large and severe wildfires, and other stressors has decreased considerably under current conditions (Safford and Stevens 2017).

Upper elevation montane zone forests largely consist of conifer forests where snow is the primary precipitation (Meyer 2013a). A mosaic of red fir and Jeffrey pine forests dominate, along with interspersed meadows, rock outcrops, lodgepole pine and montane chaparral. Red fir and lodgepole pine forests vary widely from open to closed-canopied. Red fir forests provide habitat for a variety of wildlife including great gray owl and sooty grouse. Red fir and lodgepole pine forests are the primary habitat of Sierra marten. These forests are less departed from the natural range of variation than the montane forests, with fewer changes in forest density, heterogeneity, and resilience (Meyer 2013a).

Eastside Shrublands and Woodlands (Pinyon-Juniper, Sagebrush, and Mountain Mahogany)

This zone is occupied by xeric shrub-blackbrush communities, mountain mahogany, sagebrush, and pinyon-juniper communities. Changes in climate, fire, and grazing regimes in the late 19th and 20th centuries have been particularly important factors influencing the structure, function, and distribution of arid shrublands and woodlands in this area (Slaton and Stone 2015a). There has been an increased expansion of nonnative invasive species, increased density of woody shrubs and trees into shrublands, and an overall change in successional pathways, particularly related to changing fire regimes. Some pinyon-juniper woodlands have grown into sagebrush shrub communities, due to a combination of factors including grazing, fire suppression, and climate change. Some terrestrial invertebrate species of conservation concern are supported by habitats like desert scrub, pinyon-juniper, chaparral, and sagebrush habitats. Sagebrush is important habitat for all life history requirements for the bi-state greater sage-grouse. Various at-risk butterflies that forage in sagebrush habitats are associated with sagebrush.

Caves, Cave-like Habitat, and Cliffs

Large cliffs provide habitat for a variety of raptors. Caves and cave surrogates (such as mines, adits, and vacant buildings and structures) can provide habitat for many bat species, as well as a cave obligate pseudoscorpion (*Tuberochernes aalbui*). Natural caverns and large, abandoned mine shafts exist in the plan area and many are currently gated or closed to public access to provide for public safety or to protect resources.

Aquatic Wildlife Habitat (Relevant to Terrestrial Species)

Meadows

Meadows play an important role in hydrology, water storage, erosion control, nutrient cycling, wildlife habitat, and recreation (see “Aquatic and Riparian Ecosystem” section). The condition of meadows in the Sierra Nevada bio-region (including the Inyo National Forest) was assessed and 65 percent of meadow indicators (13 of 20 indicators) were outside the natural range of variation for various characteristics related to composition, structure, and process (Gross and Coppoletta 2013). In addition, the total area of meadows in the Sierra Nevada has decreased due to past and current land use practices such as dams, diversions, and recreation; upland vegetation encroachment from conifers and sagebrush as a result of fire suppression; or from drying due to stream channel incision (Gross and Coppoletta 2013). Meadows will continue to be at risk if the precipitation pattern in the southern Sierra Nevada shifts to more rain than snow because many meadows are dependent on snowpack to sustain the water table throughout the long dry period of summer.

Meadows provide nesting, burrowing, cover, and foraging habitat for a variety of terrestrial wildlife species including mammals that burrow in the ground (like gophers and voles) and are prey for a variety of species like great gray owl and other raptors, meadow nesting birds, herbivores, insectivorous bats, and carnivores. Meadows support one or more life history requirements for several species of conservation concern.

Lakes and Ponds

Many terrestrial wildlife species depend on habitat surrounding lakes, ponds, and associated habitats like marshes to support one or more life history requirements, particularly breeding or foraging. This is especially true for the Inyo National Forest where water sources can be scarce in the arid portions of the national forest. For example, bald eagles forage in lakes and other large bodies of water and butterflies often persist adjacent to aquatic habitats.

Riparian Forests and Woodlands

Riparian forests and woodlands occur throughout the Inyo National Forest and have an exceptionally high value for many wildlife species, often supporting a higher concentration of species diversity than most terrestrial ecosystems. These areas serve as a link between aquatic and terrestrial ecosystems. Overall, within the Sierra Nevada and Great Basin bio-regions, riparian areas are outside the natural range of variation at low and mid-elevations, where fire suppression, land uses, and water development have been concentrated (Sawyer 2013). Many montane riparian communities have had an ingrowth of conifers due to the absence of fire. Without fire, this ingrowth of riparian forest woodlands will continue. Over the next century, climate change will continue to alter hydrologic and precipitation patterns, and the role of fire in riparian areas.

Riparian areas provide water, thermal cover, migration and movement corridors, and diverse nesting and feeding opportunities for wildlife (Grenfell 1988). The shape of many riparian zones, particularly the linear nature of streams, maximizes the development of a natural edge that is used by a variety of mammals, birds, and other taxa as movement corridors. For example, riparian habitats are also especially important for a variety of invertebrates that forage and persist near aquatic features like streams. Some species of conservation concern such as willow flycatcher are dependent on riparian forests and woodlands for requisite life history needs (Green, Bombay, and Morrison 2003). Other species of conservation concern such as Sierra marten benefit from the increased prey availability, mast availability, or cover and access to free water riparian forests and woodlands provide (Spencer, Barrett, and Zieliski 1983).

Status and Threats for At-risk Terrestrial Wildlife Species

This section provides information for the species status, occurrence on the Inyo National Forest, and primary stressors or threats for at-risk terrestrial wildlife species. Primary ecological zones or ecological types are described above in the “Terrestrial Vegetation Ecology” section.

Federally Listed Terrestrial Wildlife Species

Sierra Nevada Bighorn Sheep

The Sierra Nevada bighorn sheep is the only federally listed wildlife species on the Inyo National Forest. Its ecological zones, key conditions, and primary stressors or threats to persistence are as follows:

- **Primary Ecological Zone(s) or Ecological Type(s):** Upper Montane Forest, Alpine and Subalpine Zones; Meadows
- **Special Habitat Needs/Key Ecological Conditions:** Cliffs and rocky features, escape terrain
- **Primary Stressors under Forest Service Control:** Increasing tree and shrub cover
- **Primary Stressors not under Forest Service Control:** Epizootic pneumonia and contact with stray goats and sheep; climate change and loss of snow pack

Table 60. Acres of Sierra Nevada bighorn sheep critical habitat herd units in wilderness and total acres on the Inyo National Forest

Herd Unit Number	Herd Unit Name	Recovery Unit	Total Herd Unit Acres	Total Herd Unit Acres	Total Herd Unit Acres Wilderness
1	Mt. Warren	Northern	36,005	27,474	23,483
2	Mt. Gibbs	Northern	29,698	21,134	20,425
3	Convict Creek	Central	36,519	35,042	32,240
4	Wheeler Ridge	Central	80,985	55,981	51,449
5	Taboose Creek	Southern	28,816	21,644	21,036
6	Sawmill Canyon	Southern	30,521	13,470	13,028
7	Mt. Baxter	Southern	32,234	18,851	18,621
8	Mt. Williamson	Southern	32,576	28,427	27,981
10	Mt. Langley	Southern	32,862	26,693	24,982
12	Olancha Peak	Southern	30,438	30,089	29,703

Status: The Sierra Nevada distinct population segment of California bighorn sheep was listed as an endangered species in 2000, following emergency listing in 1999 (USDI Fish and Wildlife Service 1999, 2000). At the time of the emergency listing, the population was thought to total no more than 125 animals distributed across five separate areas of the southern and central Sierra Nevada (United States Department of the Interior 2000). The Sierra Nevada distinct population segment of the California bighorn sheep (*Ovis canadensis californiana*) was classified as its own Sierra Nevada bighorn sheep subspecies (*Ovis canadensis sierrae*) in 2005 (Wehausen, Bleich, and Ramey II 2005). In 2008 the taxonomic name change to the Sierra Nevada bighorn sheep (*Ovis canadensis sierra)* was officially recognized (United States Department of the Interior 2008a).

In 2008, the U.S. Fish and Wildlife Service designated approximately 417,577 acres of critical habitat for this species in Tuolumne, Mono, Fresno, Inyo and Tulare Counties (USDI Fish and Wildlife Service 2008a). Critical habitat includes 12 herd units within the recovery area on portions of the Humboldt-Toiyabe, Inyo, and Sierra National Forests and in Yosemite, Sequoia, and Kings Canyon National Parks. Ten of these herd units occur on the Inyo National Forest as listed in table 60.

Of these 10 herd units, 75 percent, approximately 278,805 acres, occur on the Inyo National Forest. The majority of the remaining portions of the herd units occur in designated wilderness managed by the National Park Service. Ninety-four percent of the herd units on the Inyo National Forest, approximately 262,948 acres, occur with designated wilderness and much of the remaining acres occur in adjacent inventoried roadless areas.

Within critical habitat, the U.S. Fish and Wildlife Service identified primary constituent elements, which are physical or biological features considered essential to the conservation of the species and that may require special management considerations or protection (USDI Fish and Wildlife Service 2008a). Relevant to management on the Inyo National Forest, these include:

1. Non-forested habitats or forest opening within the Sierra Nevada from 4,000 feet to 14,500 feet in elevation with steep (greater than or equal to 60 percent slope), rocky slopes that provide for foraging, mating, lambing, predator avoidance, and bedding as well as seasonal elevation movements between these areas.
2. Presence of a variety of forage plants as indicated by the presence of grasses (e.g., *Achnanthera* spp.*; Elymus* spp.) and browse (e.g., *Purshia* spp.) in winter, and grasses, browse, sedges (e.g., *Carex* spp.) and forbs (e.g., *Eriogonum* spp.) in summer.
3. Presence of granite outcroppings containing minerals such as sodium, calcium, iron, and phosphorus that could be used as mineral licks in order to meet nutritional needs.

The Final Recovery Plan for Sierra Nevada Bighorn Sheep was completed in 2007 (USDI Fish and Wildlife Service 2007). The recovery area for Sierra bighorn includes four recovery units: Northern, Central, Southern, and Kern. Within these recovery units there are 16 herd units, and the Inyo National Forest contains portions of the 10 herds as shown in table 60 above.

The total population of bighorn sheep in the Sierra Nevada prior to settlement is unknown, but it probably exceeded 1,000 individuals (USDI Fish and Wildlife Service 2007). At the time of emergency endangered listing in the spring of 1999, a minimum of 117 sheep could be accounted for. Bighorn numbers have increased dramatically in the Sierra Nevada since the time of the listing. The “2010-2011 Annual Report of the Sierra Nevada Bighorn Sheep Recovery Program: A Decade in Review” reported that the population as of 2012 was above 400 bighorn sheep and had expanded into ten of the twelve essential herd units needed for recovery (Stephenson et al. 2012). Recent population estimate shows the population climbing over 600 animals and range expansion into all twelve essential herd units (Runcie et al. 2015).

Threats: The vast majority of the herd units are comprised of the alpine and subalpine vegetation type with smaller amounts of other vegetation types. Due to the rocky and harsh conditions, the alpine and subalpine vegetation types are still largely similar to the expected natural range of variation with some increases in small tree densities as a result of fire suppression (Meyer 2013b).

The main mortality factors for Sierra bighorn include diseases and parasitism and predation. Numerous diseases of bighorn sheep have been documented (Bunch et al. 1999), of which pneumonia and psoroptic scabies have had the greatest population-level effects. Bighorn sheep show a high susceptibility to pneumonia, usually caused by bacteria *Mycoplasma ovipneumoniae*. Just recently researchers have learned that the bacteria *M. ovipneumoniae* influences the immune system, allowing secondary infections, like *Mannheimia haemolytica* to destroy lung tissues and often, lead to morality (Besser et al. 2008, Besser et al. 2014). The greatest risk of disease transmission is between bighorn sheep and domestic sheep and goats, which are carriers of Pasteurella-family bacteria. The potential for the transfer of disease from domestic sheep to bighorn sheep was a key factor in the endangered species listing (USDI Fish and Wildlife Service 2000).

To address the risk of disease spread from domestic livestock grazing, the Inyo National Forest worked with the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife to evaluate the risk of contact between bighorn sheep and authorized domestic sheep grazing using a risk assessment model (Clifford et al. 2009) to identify allotments or portions of allotments that posed a high risk of contact (Baumer et al. 2009, Croft et al. 2010) Considering the risk assessment for livestock and bighorn sheep contact and disease spread, the Inyo staff made site-specific decisions to close portions of active livestock grazing allotments west of Highway 395 to domestic sheep grazing where there was an identified high risk of contact.

In the Sierra Nevada, mountain lions have been identified as the primary predator of bighorn sheep (USDI Fish and Wildlife Service 2007). The amount of predation increased in the 1970s possibly contributing to Sierra Nevada bighorn sheep decreasing the use of winter range (Wehausen 1996). The California Department of Fish and Wildlife has the primary responsibility for managing mountain lions and has implemented an adaptive management strategy with regard to mountain lion predation. Since listing in 1999, the California Department of Fish and Wildlife, working with USDA Wildlife Services, has selectively removed mountain lions that preyed on bighorn sheep in the Central and Southern Recovery Units (Stephenson et al. 2012), lessening the pressure on bighorn sheep populations.

Species of Conservation Concern

Mammals and Birds: Summary of Key Ecological Conditions and Key Risk Factors

The key ecological conditions for these species and the key risk factors affecting those conditions (table 61) can be generally described as:

- Meadows and riparian habitat (great gray owl, Sierra marten, willow flycatcher, bald eagle).
- Loss of riparian habitat due to changes in water levels or diversion.
- Alpine and subalpine habitats (Nelson desert bighorn sheep, Sierra marten, Mount Pinos sooty grouse, Kern Plateau salamander).
- Temperate and habitat change related to climate change. Species dependent on seeps and springs in high elevation areas which are susceptible to climate change.
- Structurally diverse mature forests (Pacific fisher, Sierra marten, great gray owl, Mount Pinos sooty grouse, California spotted owl).
- Risk of loss of habitat and habitat fragmentation of conifer forest from wildfire outside the natural range of variability. While the current trends do not show a significant increase in the extent of forest change from wildfire on the Inyo NF, substantial areas are at a low and very low fire resiliency index indicating they are susceptible to higher amounts of crown fire than expected.
- Large trees and snags (Pacific fisher, Sierra marten, great gray owl, Mount Pinos sooty grouse, and California spotted owl).
- Risk of inadequate number, distribution, and quality of large living trees and dead trees (snags) of sufficient density, size, area and age to support key life history needs of species. Due to fire suppression, there may be fewer total patches of snags created from fire across the landscape. However, some fire-created patches of snags are exceedingly large and are created from burning older forests which competes with the habitat need for other at-risk species that need large living trees such as the Pacific fisher and Sierra marten.

Table 61. Mammal and bird species of conservation concern, ecological zones or types, key ecological conditions, and primary stressors or threats to persistence (primary stressors not under Forest Service are not necessarily discussed further)

Species	Primary Ecological Zone(s) or Ecosystem Type(s)	Special Habitat Needs/Key Ecological Conditions	Primary Stressors under Forest Service Control	Primary Stressors not under Forest Service Control
Nelson desert bighorn sheep	Upper Montane Forest, Alpine and Subalpine Zones; Meadows	Cliffs and rocky features, escape terrain	Increasing tree and shrub cover	• Epizootic pneumonia and contact with stray goats and sheep. • Climate change and loss of snow pack
Pacific fisher	Mixed conifer, Upper Montane Forests,	Old growth components including large diameter trees and snags, multi-layered canopies, large down wood, moderate to high canopy closure, structurally diverse forest	Fuels reduction and vegetation management, recreation, high severity fire, insect outbreaks; loss of connectivity/movement corridors.	• Insecticide and pesticide use; illegal marijuana growing.
Sierra marten	Mixed conifer, Riparian Areas; Meadows, Upper Montane Forests, Subalpine, and Alpine Vegetation	Old growth components including large diameter trees and snags (e.g. > 20-30 in DBH) multi-layered canopies, large down wood, moderate to high canopy closure, complex early seral habitats; Red fir, lodgepole pine	Fuels reduction and vegetation management, recreation, high severity fire, insect outbreaks; loss of connectivity/movement corridors.	• Insecticide and pesticide use; illegal marijuana growing. • Climate change and drought. • Ski resort development; roads.
Bald eagle	Large bodies of water (lakes or reservoirs) or free flowing large rivers; Montane Forest	Large live trees or snags.	Changes in timing and flow of water and water availability resulting forest management activities (fire, veg).	• Changes in timing and flow of water and water availability resulting from climate change and/or hydroelectric power.
Willow flycatcher	Riparian Meadow and Riparian meadow non ecosystem assessment types.	Dense willow or other shrub thickets within large (> 10 acres) wet meadows between 3,900-7050 feet elevation. Meadows with standing or running water needed for breeding.	Loss in connectivity between habitat patches; declining/drying meadow conditions; forest management activities (fire, veg); invasive species; livestock grazing	• Changes in timing and flow of water and water availability resulting from climate change (drought) and/or hydroelectric power. • Increasing demands for water by humans. • Nest parasitism from brown headed cowbirds/residential bird feeders.

Species	Primary Ecological Zone(s) or Ecosystem Type(s)	Special Habitat Needs/Key Ecological Conditions	Primary Stressors under Forest Service Control	Primary Stressors not under Forest Service Control
Bi-State Sage-grouse	Sagebrush, Riparian Meadow, Pinyon juniper	Large and contiguous sagebrush stands mixed with areas of wet meadows, riparian, or irrigated agriculture fields.	Pinyon-Juniper expansion and conifer encroachment, Invasive species and noxious weeds, Vegetation Management, Wildfires, Inadequate forage, Livestock grazing	• Human development • Bouldering/recreation on adjacent BML lands. • Nest predation • Changes in timing and flow of water and water availability
Mount Pinos sooty grouse	Subalpine Forest, mixed conifer	Relatively open coniferous and pine habitat with little understory cover. Woodlands and subalpine forests, large trees	Veg/fuels management, livestock grazing	• Climate change and loss of snow pack; high endemism (relict species) • Hunting
Great gray owl	Mixed Conifer and Upper Montane Forest (Red fir, Jeffrey pine, lodgepole pine); Meadows	Meadows greater than 26 acres in size, Old growth components including large diameter trees and snags, multi-layered dense canopies/forest complexity.	Livestock grazing, conifer encroachment, Veg/fuels management, Wildfire, insect outbreaks, Recreation, forest fragmentation/loss of connectivity	• Roads, trails, and structures that modify hydrologic flows within the meadows • Vehicle collisions • Predation from great horned owl • Drought stress
California spotted owl	Upper Montane and Mixed conifer (red fir, Jeffrey and lodgepole pine)	Mature forests with tree canopy cover greater than 70 percent, multilayered canopies, and an abundance of large trees and snags; pine-oak	Vegetation/fuels management, high severity wildfire, insect outbreaks, noise disturbance/recreation	• Genetic introgression from barred owls • Drought stress/climate change

Additionally some risk factors are not directly associated with a key ecological condition. For example, vehicles traveling at high speeds on primary roads can be a source of direct mortality to some species such as Sierra marten and great gray owl, while epizootic pneumonia is the primary risk factor for Nelson desert bighorn sheep. The increasing use of insecticides and pesticides, many banned from use in the United States and used exceeding label requirements, associated with illegal marijuana growing is known to directly and indirectly kill Pacific fisher, Sierra marten and other species that prey on small animals (Gabriel et al. 2012).

Nelson Desert Bighorn Sheep

Status: There is an isolated population of Nelson desert bighorn sheep within the plan area in the White Mountains at elevations ranging from 6,000 to 12,000 feet. This is the northernmost population of desert bighorn sheep in California. California Department of Fish and Wildlife has estimated this population to be about 300 sheep and the population appears stable. Most of these animals occur in the White Mountain Wilderness, with approximately 30 animals (or roughly 10 percent of the population) occurring outside this area in Silver Canyon.

Threats: Exposure to disease is the most immediate and primary risk to Nelson desert bighorn sheep persistence on the Inyo National Forest. Domestic sheep and goats are host animals for a lung disease, epizootic pneumonia caused by *Mycoplasma ovipneumoniae* (*M. ovi*), that is easily spread through direct contact with bighorn sheep. Epizootic pneumonia is widely reported to have resulted in die-offs of entire bighorn sheep herds in the western United States, including die-offs in the White Mountain herd (Besser et al. 2008). The White Mountain bighorn population has had this respiratory disease since 2009 (California Department of Fish and Wildlife 2015b). Concerns about potential spread of disease from private livestock were specifically identified in the Chalfant and Hammil Valleys west of the White Mountains (California Department of Fish and Wildlife 2015b). Some private land parcels are located immediately adjacent to the Inyo National Forest, but the majority is buffered by lands managed by the Bureau of Land Management. The Lone Pine and Silver Peak areas east of Fish Lake Valley (to the east of the Inyo National Forest in Nevada) have bighorn sheep located in those areas. These sheep have exhibited disease issues and those sheep have been observed crossing Fish Lake Valley and entering the White Mountains on the Inyo National Forest (California Department of Fish and Wildlife 2015b). These adjacent mountains are managed by the Bureau of Land Management, where the Forest Service has no jurisdiction. Occasional stray sheep have been observed in the past to trespass onto the Inyo National Forest in areas closed to livestock grazing in the White Mountains. To date, there has been one documented case of pneumonia on the Inyo, an 11-year-old male in 2016 (Nelson 2016).

Future habitat loss due to warming temperatures and climate change is also a threat, as is loss of genetic diversity. Almost all (95 percent) of the alpine habitat type is within designated wilderness, where human impacts are relatively minor. Larger scale influences such as climate and air pollution are exceptions. The relative inaccessibility of alpine habitat puts it at less risk from human induced changes. However, continued increases in tree/shrub cover and density related to climate change are expected to be significant. Recent climate models forecast a complete loss of alpine ecosystems from the White Mountains in the next 50 to 60 years. Lack of genetic diversity resulting from habitat loss and limited connectivity is another general concern; however, genetic diversity is not known to be a limiting factor at this time for the White Mountains herd within the plan area. Maintaining connectivity will be an important focus for management, especially with warmer, drier climates. Populations to the south have a high probability of extinction over the next 50 years, whereas populations in the Inyo appear to be secure (Epps et al. 2004). The populations on the Inyo National Forest may, therefore, become more important for ensuring persistence of the subspecies.

Pacific Fisher

Status: The Sierra Nevada bioregional carnivore monitoring program includes 26 sample units on the Inyo National Forest. Of these 26 sample units, four have detected fisher using track plates and remote cameras at various times over the last fifteen years (Tucker 2018). While reproduction has not been confirmed in this area, genetic analysis of hair samples have detected females multiple times, and in 2012 surveyors detected multiple individuals with genotypes consistent with a mother and 2 offspring (Tucker 2018).

Spencer et al. (2015) and Spencer et al. (2016) describe seven fisher population core areas in the southern Sierra Nevada region, five of which are occupied, and two of which are currently unoccupied. Fishers on the Inyo National Forest occupy only a small part of the Core 1 population which occurs on the Kern Plateau. This core is mostly on the Sequoia National Forest in the southeastern portion of the fisher assessment area and is the only core not on the west slope of the Sierra Nevada. Only a small portion occurs on the Inyo National Forest (13,500 acres out of 106,000 acres). The Kern Plateau has unique environmental conditions, due to differences in climate, geology, and vegetation, compared to the west-slope cores (Miles and Goudey 1998). It receives less annual precipitation than other fisher cores, and the vegetation is somewhat more open. Pinyon-juniper woodlands, canyon oak woodlands, and birch-leaf mountain mahogany are a greater component of the vegetation of the Kern Plateau than other portions of the fisher range, and California black oak, an important component of fisher habitat where it occurs, is rare or absent. The lesser accumulation of snow in this core may explain why fishers occupy higher elevations here than elsewhere in the assessment area and why martens (which are more snow-adapted than fishers) are absent (Tucker 2018).

Core 1 is the smallest occupied core area, has the lowest predicted habitat value of any core, and appears to lack potential suitable resting and denning habitat (Spencer et al. 2015). Further, Spencer et al. (2016) model the core as containing no currently suitable fisher cells. Fisher occupancy in Core 1 suggests that the current habitat models are unable to capture both the breadth of habitat that fisher will use, as well as the factors determining habitat selection in the Kern Plateau area, an area that is ecologically distinct from the rest of the fisher range in the Southern Sierra Nevada. Additional research and monitoring are warranted in Core 1 to better understand fisher habitat selection and population characteristics. Spencer et al. (2016) note that "In the meantime, all [habitat] predictions for Core 1 should be considered unreliable."

The fisher detected at sample units on the Inyo National Forest are part of the population occupying Core 1 on the Sequoia National Forest and it is unlikely that sufficient habitat or individuals exist within the Inyo National Forest to sustain a viable population within the plan area.

Threats: Key limiting factors affecting Pacific fisher and their habitats are climate change that reduces mature forest canopy cover and key structural elements and habitat fragmentation by vegetation management, fire, and insect and disease tree mortality. Since the occupied habitat in Core 1 is atypical of other cores as described above, it is unknown how vegetation changes related to climate change may affect continued fisher use. Maintaining habitat connectivity to the west with the Sequoia National Forest is necessary to allow individual animals using the Inyo National Forest to interact with the other populations within the species range in the southern

Sierra Nevada. Anticoagulant rodenticide poisoning is an emerging threat, particularly associated with illegal marijuana cultivation on public lands (Gabriel et al. 2012). Large snags and downed logs are key structural elements important for resting and predator avoidance, as well as for denning and raising young.

A vulnerability assessment for the Sierra Nevada region ranked overall vulnerability of the Pacific fisher as moderate, due to its moderate to high sensitivity to climate and non-climate stressors, moderate adaptive capacity, and moderate exposure (Kershner 2014).

Sierra Marten

Status: In addition to historic harvest of old forest habitat, marten were trapped for fur in California until 1954 and it is thought that these actions contributed to declining numbers of Sierra marten across its range (Zielinski 2014). In the southern and central Sierra Nevada, the marten is still considered well distributed but not in the northern Sierra Nevada (Kurcera, Zielinski, and Barrett 1996, Zielinski et al. 2005). Marten occur in forested areas that receive considerable snowfall (Zielinski 2014). The upper montane forests serve as primary habitat for this subspecies. Forest structure for upper montane forests in the southern Sierras at both the stand and landscape scales is more uniform and less heterogeneous than reference conditions; there has been a decrease in the density of large-diameter red fir trees in many areas but overall the upper montane forests are considered to be within the range of natural variation (Meyer 2013a). Marten locations have been observed almost exclusively west of Highway 395, with only one occurrence east of the highway in the Jeffery pine forest. Occurrence is predominantly on the western side of the national forest near Mammoth Lakes and on the Kern Plateau adjacent to the Sierra National Forest.

Threats: Key limiting factors affecting Sierra marten and their habitats are climate change, habitat fragmentation by vegetation management, fire, insect and disease tree mortality, and recreation. Anticoagulant rodenticide poisoning is an emerging threat, particularly associated with illegal marijuana cultivation on public lands (Gabriel et al. 2012) and residential rodenticide use. The capacity of the marten to adapt to climate change is limited by its reliance on deep snow for access to prey in winter through subnivean (under snow) foraging and caching of food (Hauptfeld and Kershner 2014b). The other key risk factor is fragmentation (primarily due to roads) and, at lower elevations, past timber harvest. In the future, the forested habitat the marten relies upon may be further fragmented by changes in macro and micro forest conditions or reduced by increasing wildfires associated with climate warming (Zielinski 2014, Hauptfeld and Kershner 2014b). A vulnerability assessment (Kershner 2014) ranked overall vulnerability of the marten as moderate/high, due to its moderate/high sensitivity to climate and non-climate stressors, moderate adaptive capacity, and moderate/high exposure. Sierra martens are also listed as “climate vulnerable” in the 2015 California State Wildlife Action Plan (California Department of Fish and Wildlife 2015a).

The southern extreme of the range for marten is within the southern Sierra Nevada and generally populations at the edges of their range are more at risk than those in the center. Marten are extremely sensitive to the loss and fragmentation of mature forest habitat (Zielinski 2014). It has been predicted that the range of marten in California will contract to the north and become less common and more fragmented (Lawler, Safford, and Girvetz 2012). High-intensity fires have been increasing in upper montane red fir forests and this trend is expected to increase with climate change (Schwartz et al. 2015). Changes could include a loss of red fir (Lenihan et al. 2003) and lodgepole pine habitat (replacement by white fir or loss by high-intensity wildfire) and increased competition from other carnivores no longer constrained by snow levels. Also, because of the marten's aversion to crossing large openings, large fires may fragment marten habitat and isolate populations leading to localized extirpation. The increase in large trees killed by bark beetles will create new snags at the expense of living trees used for resting and denning. Finally, increased drying conditions would lead to further deterioration of montane meadows. Drier meadows would likely reduce the prey populations on which martens depend. Recreational activities and roads that fragment contiguous habitat or compact snow may also affect marten.

Bald Eagle

Status: The bald eagle is currently protected under the Bald and Golden Eagle Protection Act of 1940, and remains listed as endangered in California by the California Department of Fish and Wildlife. Bald eagles have long been known to occur on the Inyo National Forest during winter months; with three nests observed on the forest since 2004 in the Upper Owens River and June Lake areas. The nest location in the Upper Owens River area may have subsequently been abandoned; only one adult bird has been observed in recent times and nesting activity has presumably stopped in that area. Another potential nest site may be present in the Hilton Lakes area where juvenile and adult bald eagles have been observed.

Threats: Threats to habitat include any source of extensive tree mortality within suitable nesting and perching habitat adjacent to large lakes and rivers that support bald eagle food supplies. High severity fire can eliminate large tree nesting and perching habitat. Extensive tree mortality caused by insects and diseases also remove suitable habitat. Additional threats to habitat include degradation of aquatic habitats that affect fish populations that serve as the bald eagles' primary food source. Exceptional drought conditions can increase tree mortality as well as reduce reservoir levels and prey availability. Climate change could potentially accelerate the rate at which habitat is lost (Siegel et al. 2014).

A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. Territories have been abandoned after disturbance from logging, recreational developments, and other human activities near nests (Zeiner et al. 1990).

Bald eagles may not begin nesting if human disturbance is present near nests (Zeiner et al. 1990). Human recreational activities such as boating, jet skiing, fishing, and low flying aircraft can cause disturbances to nesting birds, but some individual eagles show a moderate tolerance to the presence of humans (Buehler 2000). The U.S. Fish and Wildlife Service has provided recommendations for reducing disturbance to bald eagles, as well as recommendations for habitat management. The National Bald Eagle Management Guidelines are used for reducing disturbance at nesting, foraging, and communal roosts from a variety of human activities. These guidelines provide a sound scientific basis for reducing the effects of human disturbance on bald eagles (USDI Fish and Wildlife Service 2007).

California Spotted Owl

Status: Forest level surveys have detected California spotted owls on the west side bordering the Sequoia National Forest in wilderness, and at the farthest south end of Inyo National Forest. In the past, forest management projects on the south end of the Inyo National Forest were proposed and implemented by the Sequoia National Forest because of road systems and access, hence there was confusion about the status of spotted owls on the Inyo National Forest. According to the California Department of Fish and Wildlife spotted owl database, there are 19 data points for California spotted owl on the forest with 6 positive detections all occurring in the area just northwest of Monache Mountain. At the north end of the forest, there are also two historic occurrences in the Boundary Creek and Red Meadows area. Overall, there are only six positive detections on the Inyo National Forest with no documented nesting. The detections do not meet the criteria to establish a protected activity center or associated home range core area.

Threats: Relevant threats include habitat loss, degradation, or loss of connectivity from high-severity fire and management activities such as vegetation management or fuels management that reduces dense canopy cover, removes larger trees, or simplifies forest structure affecting prey species. Across the range of the species and relevant to the plan area but not entirely under the control of the Forest Service are identified threats from barred owls and some effects such as increased wildfires or increased tree mortality that are likely to occur from climate change.

Great Gray Owl

Status: While the great gray owl is not currently known to breed on the Inyo National Forest, there have been incidental sightings on the national forest as well as detections close to the national forest boundary making it relevant to the plan area. Even if there are no breeding pairs, owls from the neighboring Sequoia and Sierra National Forests as well as Yosemite National Park, may use the Inyo as dispersal or foraging habitat. The fragmented nature of upper montane forests on the Inyo National Forest, coupled with declining and or small population numbers of the owl, may put the species at future risk, particularly given the Inyo's location at the edge of the species range. Recent surveys and genetic sampling of the Sierra Nevada great gray owl population indicate that it is a geographically isolated population of only a few hundred individuals in the central Sierra Nevada (Hull et al. 2010).

Threats: The primary threats to habitat in the plan area are vulnerability of meadow habitat to climate change and conifer encroachment, degradation of suitable meadow habitat for foraging, and degradation or loss of conifer forest habitat especially adjacent to foraging meadows.

Future changes in climate (increasing temperatures) combined with a change from a snow-dominated to a rain-dominated system may impact meadows due to changes in the hydrologic regime. Total meadow area may decline and wet meadows may shift to dry meadows (Gross and Coppoletta 2013). This drying would decrease herbaceous biomass, which could in turn affect health rodent populations for the owl. Conifer forests are also vulnerable to climate change. Anticipated trends for red fir forest, Jeffrey and lodge pole pine and mixed conifer are similar; trending towards higher fuel loading, and changes in forest structure and composition associated with fire suppression coupled with a changing climate (Slaton 2013).

In addition, projected increases (2006-2050) in mountain pine beetle activity for high-elevation pine forest will have substantial cascading impacts on subalpine forest ecosystems, leading to outbreaks that can cause significant changes in forest structure, function, and composition (Meyer 2013a). Habitat degradation from livestock grazing and timber harvest are considered significant threats to great gray owl persistence (Wu et al. 2016) because livestock grazing can result in the removal of vegetative cover required by critical prey species (Beck and Winter 2000; Kalinowski, Johnson, and Rich 2014a), and because timber harvest may result in reduced canopy cover, removal of nest structures, and potentially disturb breeding owls. Disturbance from increased recreation is also a concern because in Yosemite National Park, human disturbance related to campgrounds and their development has been documented (Maurer 2006, Bull and Duncan 1993).

The fragmented nature of upper montane forests on the Inyo National Forest, coupled with declining and or small population numbers of the great gray owl, and reductions in meadow habitat from climate change and conifer encroachment put this species at risk. Species viability of great gray owl on the Inyo National Forest is currently uncertain.

Bi-state Greater Sage-grouse

Status: The sage-grouse has experienced significant range and population reductions in many areas of eastern California and western Nevada where the species is a permanent resident. It is designated as a (third priority) California species of special concern in its nesting and breeding (lek) grounds. The U.S. Fish and Wildlife Service recognized this species as a distinct population segment under the Endangered Species Act and proposed the bi-state distinct population segment of greater sage-grouse as threatened under the Endangered Species Act in 2013 (USDI Fish and Wildlife Service 2013). Through collaborative efforts, a bi-state action plan was developed (Bi-State Technical Advisory Committee Nevada and California 2013) and funding commitments were made which led the U.S. Fish and Wildlife Service to make a final decision in 2015 that listing the species under the Endangered Species Act was not warranted (USDI Fish and Wildlife Service 2015b).

The bi-state population of greater sage-grouse occurs in portions of Carson City, Lyon, Mineral, Esmeralda, and Douglas Counties in Nevada, and of Alpine, Inyo, and Mono Counties in California and is only found on the Inyo National Forest. The State wildlife agencies in Nevada and California have jointly identified five bi-state area population management units (PMUs): Pine Nut, Desert Creek-Fales, Mount Grant-Bodie, South Mono and White Mountains. The most recent population study showed that sage-grouse populations within the bi-state area were stable from 2003 to 2012 (Coates et al. 2014). One exception was the Parker Meadow population in the South Mono Population Management Unit; the study showed that this subpopulation is at risk of extinction (Coates et al. 2014). However, this subpopulation has relatively low influence on the overall population trend averaged across the entire bi-state area (Coates et al. 2014).

Threats: Key risk factors to sage-grouse include pinyon-juniper expansion and ingrowth of conifers into sagebrush habitats, the spread of invasive species and noxious weeds, predation by ravens, and human development. On the Inyo National Forest, pinyon pine has grown into lower elevation sagebrush ecosystems at a high rate due to many factors such as wildfire suppression, historic livestock grazing, and changing climate (Slaton and Stone 2015a, b). Jeffery pine has also grown into sagebrush ecosystems and threatens the condition of sage-grouse habitat.

In addition to conifer ingrowth, cheatgrass is invading sagebrush ecosystems and adversely affecting habitat condition. Cheatgrass becomes established after wildfire or other disturbance and changes the structure and composition of sagebrush habitat. Consequently, cheatgrass also makes habitat more flammable and susceptible to subsequent wildfires (Brooks and Minnich 2006).

Past land management practices and weather patterns may be correlated with a decrease in understory and shrub cover in sage-grouse habitats that has been linked with increased nest predation by ravens (Coates and Delehanty 2010). Although it has not been measured, the extent of human development impacting sage-grouse habitat has been limited and most impacts have probably occurred on private land development in the Chiatovich Creek area east of the White Mountains in Nevada. In addition to reducing and degrading habitat condition, developments can impact sage-grouse use and movement in habitats, especially winter range use where new roads and housing development fragment habitat.

Infrastructure (fences and posts) has been identified as an additional threat to greater sage-grouse because they may increase predation risk (USDI Fish and Wildlife Service 2015; Hall, Gardner, and Blankenship 2008). The study by Hall et al. additionally suggest West Nile virus as a potential threat; however, U.S. Fish and Wildlife Service did not consider West Nile to have "serious consequences" for the population.

Mount Pinos Sooty Grouse

Status: The Mount Pinos sooty grouse has likely been extirpated from much of its historic range, which occurred from Kings Canyon south and west to the Mt. Pinos region of Kern and Ventura Counties (Bland 2013a, Zeiner et al. 1990). It is now most abundant at the northern limits of its current range which occurs south of 37 degrees north latitude. On the Inyo National Forest, this includes areas south of the town of Independence in suitable habitat found in Kearsarge Pass, Onion Valley, Mt Whitney and Mt Whitney Portal, Olancha Creek, and Haiwee Canyon (Bland 2013a, 2017). Surveys over the past century indicate the range of Mt. Pinos Sooty Grouse has receded roughly 100 miles and recent data suggest that the northward decline is continuing (Bland 2013a).

Threats: Threats include incompatible timber harvest, fire suppression and altered fire regime, livestock grazing, land development, recreational use of habitat, hunting, and climate change. Sooty grouse are associated with upper elevation conifer forests that may be affected by vegetation management and climate change. In early spring, sooty grouse congregate in open mature stands of conifers near the crests of ridges (Bland 2013a). These "hooting sites," or "spring activity centers" are traditional, and are returned to year after year, generation after generation. Loss of large trees from these areas are detrimental to grouse (Bland 2013b). In late spring and summer through fall, females and their young are associated with meadows and other mesic areas. Degradation of meadow and mesic areas can negatively effect brood production. In winter, sooty grouse seek dense conifer stands at high elevations where they subsist almost entirely on fir needles and buds. Forest heterogeneity is important to maintain for grouse. Groups or clumps of conifers, especially in fir stands provide important food and thermal and hiding cover for grouse.

Willow Flycatcher

Status: Once common throughout the western United States, the willow flycatcher is gone from much of its range. The willow flycatcher is a polytypic species, with three subspecies breeding in California: *E. t. brewsteri* in isolated patches in northern California and along the western slope of the Sierra Nevada; *E. t. adastus* along the eastern slope of the Sierra Nevada; and *E. t. extimus* (southwestern willow flycatcher) breeding in riparian areas of southern California. Two of the three subspecies of willow flycatcher are known to occur on the Inyo National Forest; the federally endangered southwestern willow flycatcher, *E. t. extimus*, is not known to occur on the Inyo. It is not possible to identify the subspecies apart visually, only genetically. The 2004 Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004d) listed willow flycatcher sites on eight sites on the Inyo National Forest. These sites were considered occupied, historically occupied or conditionally occupied based on records of detection. More recently, The Institute for Bird Populations (IBP) synthesized data on willow flycatcher detection sites from numerous entities (Federal, State, and private) and found that the Inyo National Forest has a total of 32 active flycatcher sites (2,238 acres), constituting 7 percent of all currently used flycatcher habitat in the Sierra Nevada (N= 285 sites, 33,367 acres total). The authors of that study note that post and pre-breeding willow flycatchers in meadow habitat are regularly detected at MAPS stations and during point counts in Yosemite National Park and the Stanislaus, Sierra and Inyo National Forests (Loffland et al. 2014).

On the Inyo National Forest, potential habitat can be found in the riparian meadow and riparian non-meadow ecological assessment types. The largest riparian meadow systems on the Inyo occur on the Kern Plateau (approximately 10 percent) while about 1.5 percent of the land area in the Ansel Adams and John Muir Wildernesses is meadow. However, the willow flycatchers documented on the Inyo National Forest in the lower Rush Creek area occur in atypical habitat. Lower Rush Creek is at roughly 6,500 feet above sea level and lies within a matrix of Great Basin big sagebrush scrub. After decades of heavy diversion, it has been under passive restoration for 22 years. Livestock grazing, once heavy on lower Rush Creek, has been excluded from the riparian corridor for over 10 years by the Inyo National Forest and the Los Angeles Department of Water and Power. Although lower Rush Creek (often referred to as the “Rush Creek Bottomlands”) has one of the widest riparian corridors in the Eastern Sierra, the corridor’s riparian vegetation can be patchy, with significant amounts of sagebrush scrub mixed within patches of riparian obligates that are supported by current and historic side channels (McCreedy 2005).

Threats: Key threats to willow flycatcher include loss of meadows and riparian habitat due to changes in water levels, diversions, grazing, meadow drying and conifer encroachment, snow pack and changes in spring precipitation related to climate change. Livestock grazing can negatively affect flycatcher habitat, however, on the Inyo National Forest no known willow flycatcher sites currently co-occur on active livestock allotments. Unpublished Inyo National Forest data indicate that all stream reaches through meadows in grazed and rested allotments fell within expected values for width and width-to-depth ratios, except for Monache Meadow, which showed that widths were wider and depths shallower than they should be for a functioning hydrologic system. In the past 20 years, much restoration work has been completed in meadows on the Inyo, especially the Kern Plateau. Observations by national forest staff suggest that even in allotments that remain open to livestock grazing, restoration and changes in grazing management appear to have improved stream and meadow condition overall. During the recent forest plan assessment process, grazing monitoring data for 69 key meadow areas show that 35 percent were in excellent condition, 35 percent were rated as good, 23 percent as fair, and 7 percent as poor. Lower ratings indicated lack of surface litter, greater bare ground cover, soil compaction and/or rilling. Higher ratings were correlated to greater plant diversity and vegetation cover.

Additional risk factors that affect nest success through increased predation rates and nest parasitism can occur both on and off the forest. Placement of bird feeders in residential areas outside the Inyo is known to attract brown-headed cowbirds, which in turn leads to nest parasitism of willow flycatchers. Brown-headed cowbird nest parasitism has also led to direct loss of nest productivity and recruitment on the national forest, especially in the lower Rush Creek area where it is the primary cause for low productivity (McCreedy and Burnett 2011). Loffland et al. (2014) note historic locations on the Inyo National Forest in close proximity of one another, including the area west of Mono Lake in the vicinity of Rush Creek and Lee Vining Creek. These areas may be candidates for meadow restoration efforts; however, it is believed that high cowbird densities in this area resulting from backyard bird feeders and other human-induced attractions (rather than livestock grazing) would need to be addressed before attempting to attract willow flycatchers into those areas.

Outside the Inyo National Forest, water diversions have impacted willow flycatcher habitat. As stated in the Conservation Assessment, riparian vegetation in the Owens Valley located downstream of the intake to the Los Angeles aqueduct has dramatically changed to a more xeric condition due to the lack of water, and no longer provides habitat for nesting willow flycatchers (Green, Bombay, and Morrison 2003). Increased water demands coupled with more frequent drought events and drying conditions will continue to act as negative stressors on flycatcher habitat, although some willow flycatchers species were found to be at lower risk (out of 358 total bird taxa analyzed) with regard to climate change vulnerability than other bird species (Gardali et al. 2012).

Terrestrial Invertebrates: Summary of Key Ecological Conditions and Key Risk Factors

Butterflies

The butterflies are limited to areas with suitable host plants and other, often unknown factors. The San Emidgio blue is known to be limited by other factors since it doesn't occur in some areas, even if the host plant is present. It has a complex symbiotic relationship requiring an ant (*Formica pilicornis*), a scale species (*Ceroplastes irregularis*), and one of three Atriplex or shadscale plant species (*Atriplex lentiformis, A. cannescens, and A. polycarpa*) are necessary to complete its lifecycle. Climate change is a substantial risk factor for many of these species because they have very limited distributions, and frequently disjunct populations. Butterflies can be affected by changed seasonality of rain and temperature that might cause a shift in the survival or flowering season of host plants.

Status: The various butterfly species of conservation concern occur mostly at high elevations and are primarily associated with wet meadow or riparian habitats. Butterflies inhabit virtually every part of an ecosystem largely determined by their dispersal ability, feeding and reproductive habits. However, the butterflies of conservation concern are, as a rule, highly endemic, meaning populations occur only in very localized areas and those areas are extremely rare. Habitat suitability for many species depends on microsite conditions that can vary with each life stage. Having both host and nectar plants available are usually critical requirements, and where both are present it may limit populations to the boundary of such habitats. For some, the majority of their life stages are limited to one or a few plants for larval, juvenile or pupa, and adult stages.

Threats: The primary threat for butterflies of conservation concern is restricted distribution and endemic populations. This condition makes populations very susceptible to subtle habitat changes and perturbations that may result from water withdrawal, overgrazing, invasive species, conifer encroachment, pesticide use, unauthorized off-highway vehicle use, road expansion, development, mining, and climate change.

The host plants of all of these species can be susceptible to ground disturbance and some are threatened due to climate change. Most species of butterflies have evolved to be very selective and will only lay their eggs on one or two specific species of plants which also serves as a primary food source. Changes in temperature extremes and precipitation could affect host plant availability. Fires that burn with low to moderate severity can regenerate flowering plants in fire-adapted ecosystems and an altered fire regime is typically a threat to these taxa. Grazing likely has different impacts on different species of butterfly depending on intensity, mostly through impacts on host plants. Application of pesticides that are used to control nuisance insects or other pests or to kill target plants are threats to many butterflies if they are not selective or if they affect larval plants or habitat. Hobby collecting of butterflies can also impact populations and more information needs to be gathered with respect to this potential threat.

Table 62. Terrestrial invertebrate species of conservation concern, ecological zones or types, key ecological conditions, and primary stressors or threats to persistence (primary stressors not under Forest Service are not necessarily discussed further)

Species	Primary Ecological Zone(s) or Ecosystem Type(s)	Special Habitat Needs/Key Ecological Conditions	Primary Stressors under Forest Service Control	Primary Stressors not under Forest Service Control
Apache Fritillary (Apache Silverspot Butterfly)	Meadows in the Alpine zone, Springs and Seeps	Host larval plant is *Viola neprhropylla.* Presence of bull thistle *Cirsium vulgare* and lavender thistle *Cirsium neomexicanum* also appear important.	Loss of meadows and riparian habitat due to changes in water levels, diversions, grazing, meadow drying and conifer encroachment. Invasive species and pesticide applications that inadvertently impact host plant species.	Municipal water diversions, loss of snow pack and changes in spring precipitation related to climate change. Restricted distribution.
Boisduval's blue	Riparian Conservation Areas (Meadows, Springs and Seeps	Perennially wet marshes and wet meadows near springs, seeps and riparian areas where host plant *Collinsia parvifloria* occurs.	Invasive species (e.g. cheatgrass) and pesticide applications that inadvertently impact host plant species. Recreation. Roads construction.	Mining, Restricted distribution, drying of meadows due to climate change.
Mono Lake Checkerspot	Riparian Conservation Areas (Meadows, Springs and Seeps	Perennially wet marshes and wet meadows near springs, seeps and riparian areas where host plant *Collinsia parvifloria* occurs.	Pesticide applications that inadvertently impact host plant species. Recreation, Roads construction, Conifer encroachment, timber harvest and livestock grazing.	Restricted distribution, drying of meadows due to climate change.
San Emigdio Blue	Desert scrub, Special Habitats.	Washes, alluvial fans and habitats that include desert saltbush species (*Atriplex*) and associated scale insects and ants.	Invasive species and pesticide applications that inadvertently impact host plant species. Ground disturbing activities including fire management, unauthorized OHV travel, and road expansion.	Restricted distribution/isolated populations and ant/larval symbiotic relationship. Agricultural and urban development (potential expansion of Highway 395). Drying of meadows due to climate change and
Sierra Sulphur	Riparian Conservation Areas (Meadows, Springs and Seeps	High elevation, perennially wet marshes and wet meadows near springs, seeps and riparian areas where host plant *Vaccinium cespitosum* occurs.	Any activities that that alter hydrology/water flow and increase sedimentation including grazing and water impoundments, ground disturbing activities such as timber harvest.	Endemism/ restricted distribution; Municipal water diversions, loss of snow pack and changes in spring precipitation related to climate change that cause meadow drying.

Species	Primary Ecological Zone(s) or Ecosystem Type(s)	Special Habitat Needs/Key Ecological Conditions	Primary Stressors under Forest Service Control	Primary Stressors not under Forest Service Control
Square Dotted Blue	Alpine and Subalpine Zones, Meadows.	High elevation, scree slopes, barren ridges and pumice fields where host plant *Eriogonum* (buckwheat plants) occur.	Invasive species and pesticide applications that inadvertently impact host plant species, any ground disturbing activities that damage microsite conditions. OHV travel in Badger Flats and Mazourka Peak.	Restricted distribution (only one location on the forest), Mining (pumice harvest). Invasive species and pesticide applications that inadvertently impact host plant species.
A cave obligate pseudo-scorpion	Caves	Poleta Cave	Recreational caving	Mining, high endemism (relict/ancestral population).

A Cave Obligate Pseudoscorpion

Status: Found only on the Inyo National Forest, this species is similar looking to a scorpion. Pseudoscorpions, commonly known as "false scorpions," pose no threat to humans and are members of the spider family. This species type locality is only known from one cave in the Inyo-White Mountains, at about 7,200 feet in elevation. The cave is gated and locked.

Threats: Recreation or potential mining use could impact this species. Disturbance to occupied caves that could impact this species include smoke from fires, trampling, and changes in moisture or temperature conditions. Climate change may be the greatest threat to cave habitats by altering temperature and humidity; most troglobites have narrow environmental tolerances (Badino 2004).

Environmental Consequences to At-risk Terrestrial Wildlife Species

Environmental consequences are first evaluated for the major ecological zones and vegetation types to provide context for potential changes in habitat or conditions which is then evaluated for each at-risk terrestrial wildlife species. While old forest habitat elements and complex early seral habitat can occur in any ecological zone, these two specific habitats are described as part of the Sierra Nevada montane ecological zone as they are most relevant to conifer dominated forests. For the plan revision alternatives, the evaluation focuses on the ability of the coarse-filter components to achieve the desired conditions and provide habitat sufficient to support the persistence of associated species. Where fine-filter plan components exist for a species, those plan components are evaluated under the various alternatives for their ability to provide habitat sufficient to support the persistence of that particular species.

Consequences Common to All Alternatives

Range Management

All alternatives maintain the same level of livestock grazing as the current plan in alternative A and permitted livestock grazing would be managed the same as under current practices, unless changed by future project-specific decisions. In the plan revision alternatives, parts of the current forest plan and amendments related to monitoring protocols and processes for grazing permit administration have been moved to a forest supplement for range program management where they can more regularly be updated with new scientific information.

Grazing can adversely affect habitat for terrestrial wildlife species, particularly those that nest or forage in meadows, riparian areas, and grasslands. Direction for livestock grazing management and direction for riparian conservation areas for desired conditions and livestock grazing in meadows is would not vary by alternative. The plan direction is anticipated to improve livestock grazing management, and result in positive meadow and riparian conservation area trends over time. These actions improve vegetative conditions, stability and resilience over time.

Grazing can cause structural changes to willow flycatcher habitat that could "expose nests, reduce substrate for insects, and diminish foliage cover that protects nests" (Mathewson et al. 2007). While poorly managed grazing can change the hydrologic and vegetative characteristics of meadows and contribute to poor quality habitat for nest selection and increased visibility (vulnerability) of nests to predation (Brookshire et al. 2002; Auble, Friedman, and Scott 1994; Scott, Skagen, and Merigliano 2003), grazing management direction is designed to minimize and avoid these effects.

Some grazing can be beneficial for butterflies, but heavy grazing can degrade habitat. Livestock grazing, especially in and near Sierran meadows, may affect breeding success of the Sierra marten by reducing understory vegetation (Zielinski 2014). Livestock grazing levels have been substantially reduced over the last several decades and some grazing allotments are now currently vacant and ungrazed. Specific decisions on the numbers, types, seasons, and level and intensity of livestock grazing are made during allotment management planning. Allotment management plans also include monitoring of grazing activities so that the need for adjustments to livestock grazing practices and amounts can be identified and addressed in annual operations or in the allotment management plans. This would be the same under all alternatives. If new grazing allotments or activities are proposed in habitat that supports a threatened, endangered, proposed, or candidate species, the U.S. Fish and Wildlife service would be consulted prior to making allotment management plan decisions.

Wilderness

Management of designated and recommended wilderness can benefit species by precluding certain ground-disturbing management activities (like timber harvest and road building) that might reduce habitat quality, and by limiting mechanized and motorized activities such as mountain biking and off-highway-vehicle use that could cause disturbance to individuals during sensitive times of year such as breeding periods. This conservation approach of restricting activities has long been employed as a means to help protect natural resources, including wildlife, from degradation and disturbance associated with human actions that alter the environment. The benefit of precluding these activities is somewhat limited, however, because many of the areas proposed for recommended wilderness are already managed as inventoried roadless areas or they are areas that are steep and remote with limited access and where the risk of ground-based activities is minimal.

Wilderness management areas are also locations where wildfires are often managed to meet resource objectives, such as restoring fire as a key ecosystem process, which can substantially improve habitat condition, heterogeneity, structural diversity, and species composition of vegetation. Fire management activities in designated and recommended wilderness employ minimum impact suppression tactics to the extent possible to reduce the human impact on wilderness character which tends to minimize impacts to wildlife habitats. All alternatives encourage managing wildfires to meet resource objectives when it is safe to do so, but the plan revision alternatives provide clearer plan direction than alternative A, which should result in more wildfires being managed and more acres having fire restored over time, especially in designated and recommended wilderness areas. Over time this is expected to improve the resilience of habitat by lessening the risk of uncharacteristic changes in habitat from wildfires.

However, designated and recommended wilderness management direction can also impact species by precluding or limiting restoration activities. In areas where vegetation and fuels have been impacted by past management, wildfires are becoming increasingly large and often have high-severity impacts to habitats that are outside the natural range of variation. Despite the desire to restore fire as an ecosystem function, many wildfires will be difficult to manage safely given the current condition and wilderness management direction generally limits the use of prescribed fire. The amount of wildfire is predicted to increase in the future in all alternatives (See “Fire Trends” section) and increased wildfires could cause the loss of forest habitats in designated and recommended wilderness areas.

Wilderness areas are expected to have a continuing risk of disturbance to wildlife from wilderness users, which is projected to increase overall with population increases. Visitor use may change in some areas that are managed as recommended wilderness areas. If areas already have visitor use the change could be slightly more if people are attracted to trails that are associated with wilderness but use could also be slightly less if existing users want pursue activities that were allowed but may be discontinued after an area is managed as recommended wilderness. If substantial conflicts with recreation uses and wildlife are known, all alternatives have direction to manage the conflict. Some species like Sierra Nevada bighorn sheep have specific direction and others would apply forestwide guidance.

Ground-disturbing activities are generally limited within designated and recommended wilderness areas, including when the purpose is ecological restoration. This may limit the opportunities for restoration of some sagebrush dominated areas important to sage-grouse. In some cases, alternate methods may be used that are compatible with maintaining wilderness character but they may have higher implementation costs resulting in fewer acres restored or causing other restoration activities to be deferred or delayed. This is discussed in more detail for the bi-state sage-grouse below.

Climate change has been associated with and will continue to influence shifts in ecological processes and patterns, and species ranges, movements, and phenologies (Bradley et al. 1999, Safford et al. 2012, Cole and Yung 2012) among other newly emerging patterns. Biotic communities may shift in complex ways, such as some species may shift sooner or later than others, or in different geographical directions than others causing disruptions in ecosystem functions. In this way, novel species assemblages may form with new predatory or competitive interactions (Stralberg et al. 2009). While wilderness designation can benefit terrestrial wildlife species, protection of species and community assemblages may be limited to a snapshot in time and may not be protective in the future if natural processes aren’t sufficient to maintain habitat conditions due to factors such as climate change, large high-intensity fire, nonnative species invasions (like invasive plants and barred owl), insect outbreaks, and pathogens, among others.

Consequences Common to Alternatives B, B-modified, C, and D

Recreation Management

As explained in the “Sustainable Recreation” and “Economic Conditions” sections, there is an expected increase in recreation demand as regional populations grow. This trend, coupled with improved recreation site conditions and recreation access across the alternatives, has the potential to increase the amount of recreation use in both dispersed and developed areas. This could increase the potential for disturbance during the breeding season and other sensitive time periods for at-risk species and could result in localized impacts to habitat conditions. Some areas like meadows, riparian habitats, and ponds and lake shores provide important habitat to at-risk species but are more sensitive to trampling and compaction and are also attractions to recreationists in the hot and dry summer months. Some areas like cliffs and rocky outcrops may experience greater impacts than other habitats from increased recreation use because these areas tend to receive more intense or frequent recreation use due to the popularity of rock climbing and bouldering. Cave exploration can directly and adversely affect bat species that may be roosting or rearing young and cause site abandonment. Human disturbance from various kinds of recreation activities like camping, rock climbing, road and trail use, off-highway or over-the-snow vehicle operation, is a known threat for species like bald eagles, Sierra marten, and great gray owl which are more sensitive to human disturbance.

In these alternatives, plan direction for sustainable recreation more explicitly recognizes the need to avoid or mitigate recreation impacts to at-risk species compared to alternative A, especially for dispersed recreation and when siting new recreation facilities. As projects are planned, the alternatives include forestwide plan direction to include mitigations to reduce impacts on at-risk species in order to reduce the ecological impact of recreation facilities and recreation uses. For some species or circumstances more focused direction was developed. For example, these alternatives include guidance to install bat gates at cave and mine entrances or restrict access by other means when bat maternity colonies or hibernacula may be adversely affected. Under these alternatives there would be an emphasis on addressing the backlog of deferred maintenance at developed recreation sites and on trails. These alternatives would benefit at-risk species over the plan period by mitigating the disturbance and habitat impacts from recreation uses, but it will be increasingly challenging to mitigate impacts in the future as recreation demand continues to grow.

Plan Components Developed for At-risk Terrestrial Wildlife Species

Alternatives B, B-modified, C, and D share most of the same vegetation-focused desired conditions. The desired conditions by major terrestrial vegetation types were listed in table 26 and table 27 in the “Terrestrial Vegetation Ecology” section. These ecosystem level plan components provide for a broad range of ecological conditions important to ensure habitat diversity for wildlife. In addition, other desired conditions specific to wildlife.

Table 61 and table 62 list the threats and principal habitats for each terrestrial wildlife species of conservation concern. For each species, appendix F (persistence analysis for species of conservation concern) lists the primary applicable plan components that provide for the ecological conditions necessary to ensure or contribute to the persistence of the species. While many other plan components may also provide generally for ecological conditions that would benefit a species, only the primary plan components are identified. The consequences of plan direction are described in the analysis presented by species below.

Consequences to Major Ecosystem Zones, Ecosystem Types, and Habitats

The analysis by vegetation zone is based in part on the “Terrestrial Vegetation Ecology” and “Agents of Change” sections. These sections describe consequences to vegetation that affect habitat. The alternatives vary in their ability to reduce the risk of habitat degradation across large forested areas from large-scale disturbances like drought-related vegetation mortality, large high-intensity fire, and insect outbreaks (see “Agents of Change” section). The alternatives also vary in their ability to move toward the desired conditions for structure, composition, and resilience of each vegetation type (see “Terrestrial Vegetation Ecology” section).

Subalpine and Alpine Zone
(Upper Montane Forests, Subalpine, and Alpine Vegetation)

This section compares the environmental consequences of the five alternatives on the dominant habitat types associated with the at-risk terrestrial wildlife that inhabit this zone, such as red fir and conifer forests, sagebrush (White Mountains), rocky terrain, and barren habitat. Environmental consequences for high elevation aquatic habitats such as meadows, riparian woodlands and forests, and lakes and ponds are described below in the “Aquatic Habitat” effects analysis within this section.

Under all alternatives, vegetation treatments are not prioritized in the upper montane zone except where needed around communities, developed recreation sites, and various assets like communication towers, water supplies, and powerlines. Much of this zone is in designated wilderness or has limited access. Habitat within wilderness areas would remain generally undisturbed by management activities because natural processes are the primary mechanism of habitat maintenance in these areas. Relatively low amounts of mechanical treatment are expected in this zone, and a heavier focus is on the use of wildfires managed to meet resource objectives. There is very little to no mechanical treatment expected in subalpine and alpine zones except potentially along strategic roads and ridgelines outside of designated wilderness where treatment might facilitate prescribed burning or managing future wildfires to meet resource objectives. Natural features like rock outcrops, areas of talus, or barren areas that are naturally open with little to no vegetation and fuels.

Limited mechanical treatment would occur in forested portions of these zones. Where restoration is conducted, the emphasis would be on the use of managed wildfire due to the more remote locations. Due to limited mechanical restoration treatments under this alternative, vegetation in these zones would likely have the lowest resilience to climate change and would continue to be susceptible to large, high-intensity wildfire, except for portions of the Kern Plateau where the restoration of fire has been occurring (see the “Fire Trends” section). In alternative A, habitat conditions would be likely to remain the furthest from the natural range of variation of all alternatives. Condition of forested habitat would be more vulnerable to degradation than under other alternatives. Vegetation management under this alternative is generally prohibited from removing large-diameter trees. Where they occur in high density clusters, this leaves these large trees at a greater risk of dying from insect outbreaks, spread of diseases and pathogens, and large wildfire with high severity impacts. Although wildfires in forested areas in these higher elevation zones tend to occur less frequently than in lower elevations and most are small with mixed severity effects, under alternative A, burned area, fire size, and fire intensity are predicted to increase two to four fold (see the “Fire Trends” section).

Ecosystems in these zones are among the most vulnerable to climate change and would continue to have low resilience to climate change (see “Terrestrial Vegetation Ecology” section), especially under alternative A because of the limited ability to restore habitat in these zones. Warming temperatures and drought conditions have the potential to seriously degrade habitat condition over time, including drying of high alpine water sources that are particularly important to the Sierra Nevada bighorn sheep and of higher elevation meadow systems important to sage-grouse brood-rearing.

Restoration under alternatives B and B modified would result in improved structure and resilience of habitat condition in these zones because it would provide a greater opportunity to treat vegetation and uses more managed wildfire for resource benefit than alternative A. Although fires are naturally infrequent in the upper montane, subalpine and alpine zones, they are an important part of the disturbance regime (see “Terrestrial Vegetation Ecology” section). These alternative also have specific desired conditions for these habitats to more clearly direct management actions. However, these treatments are strategically placed to try and prevent loss of large areas of habitat from large wildfire and there are plan components to incorporate consideration of habitat fragmentation and connectivity at fine scales during project design. Overall these alternatives would be better at improving and sustaining the condition of wildlife habitat over the long term than alternative A.

Although the emphasis of treatments in the upper montane zone under alternatives B and B modified is mostly on Jeffrey pine forests, this emphasis is not anticipated to adversely affect habitat condition or quantity for species more strongly associated with other forest types. There would also be some restoration in red fir forests and in white pine stands at risk from white pine blister rust that are greatly deviated from desired conditions and at high risk from climate change. Jeffrey pine forests are more departed from desired conditions (and the natural range of variation) than many of the other forest types in this zone. Therefore, treatments focused on this forest type (and particularly on reclaiming the dominance of Jeffrey pine trees) would likely benefit many terrestrial wildlife species, particularly where these treatments also improve heterogeneity, structural complexity, and resilience.

However, treatments would be relatively less focused in habitats that are known to support some at-risk terrestrial wildlife species like the California spotted owl and Sierra marten that are associated with high elevation closed canopy red fir forest. These forest types will be restored in this zone for structural complexity, heterogeneity, and resilience but not to the degree that Jeffrey pine forests will be restored. These habitats are generally not as far departed from desired conditions as Jeffrey pine forests and can continue to support wildlife needs. Still, focused treatments in these forests to promote resilience would be conducted with the needs of these species in mind during project development, such as considering Sierra marten habitat strategies. These restoration treatments would promote resilience to large-scale disturbances like high-intensity fire that can remove large areas of habitat.

In the Kern Drainage, where upper montane forests (Jeffrey pine, red fir, lodgepole pine, aspen) have been restored in the last 15 years through wildfires managed for resource objectives (Fites-Kaufman, Noonan, and Ramirez 2005, Ewell, Reiner, and Williams 2012, Vaillant 2009, Meyer 2015b), at least one-third to one-half of the area is similar to desired conditions (see “Fire-Trends” and “Terrestrial Vegetation Ecology” sections). Most of this area is in the wildfire maintenance zone and would continue to have wildfires managed for resource objectives to maintain and further restore conditions similar to the natural range of variation for vegetation, fire, and climate resilience. Habitat in these areas would be resilient.

Alternatives B and B modified include desired conditions for climate change resiliency in subalpine and alpine ecosystems. Although the more rapid pace and larger scale of restoration under these alternatives (especially the use of managed wildfire) is anticipated to create more resilience to climate change in the upper montane, subalpine, and alpine zones, the zones would continue to have low resilience to climate change overall (but better than under alternative A) because of limited restoration rates and the high climate exposure of these areas (see “Terrestrial Vegetation Ecology” section).

Overall, treatments to increase upper montane heterogeneity and resilience, and improve conditions for whitebark pine under Alternative C have a greater potential than alternative A but less than B or B modified to improve habitat condition for terrestrial wildlife species because of limited treatment rates. Habitat under alternative C would continue to be at risk to large, high-intensity wildfire similar to alternative A. Although alternative C emphasizes prescribed fire and wildfire managed to meet resource objectives, techniques that are most likely to be used in the wildfire maintenance and general wildfire zones, this alternative proposes fewer total acres of treatment than alternatives B, B modified or D. There is additional area in recommended wilderness, increasing the proportion of upper montane and subalpine zones in areas with limited management (wilderness, wild and scenic river corridors, and inventoried roadless areas) from 74 to 79 percent of the upper montane zone as compared to alternative A. With 98 percent of the subalpine and alpine zone already in less managed areas, these combined areas would provide for more extensive connecting area for wide-ranging species like Sierra marten.

Alternative C also has less ability than alternatives A, B, B modified and D to use mechanical techniques that could better reassert Jeffrey pine trees as the dominant tree type in these forests and promote overall heterogeneity and structural diversity. This alternative does not treat at the landscape scale like would occur in alternatives B, B modified or D. Landscape treatments have a greater potential to restore resilience. Alternative C would result in lower climate change resilience than the other action alternatives due to the lower treatment rates. It would have slightly better climate change resilience than alternative A by focusing some treatment to improve conditions for whitebark pine. Overall alternative C is not as able as alternatives B, B modified or D to improve habitat condition for at-risk terrestrial wildlife species.

Effects to the condition of habitats that support at-risk terrestrial wildlife species under alternative D are the same as described under alternative B but the increased pace and scale of restoration under alternative D is anticipated to more rapidly achieve resilience, heterogeneity, structural complexity, and composition than alternatives B or B modified. Alternative D is also anticipated to have the greatest resilience to climate change, and large high-intensity fires (followed by alternative B and B modified) because of the faster restoration rates and more acres treated (see “Fire Trends” and “Terrestrial Vegetation Ecology” sections). More short-term (implementation-related) impacts could occur to habitat as a result of the faster pace and scale of restoration treatments. But as described under alternative B and B modified, these potential impacts are intended to improve long-term habitat condition and reduce the risk of loss from the landscape. Such impacts would be project- and site-specific and would be evaluated during project development.

Sierra Nevada Montane Zone

When comparing the alternatives on their impacts to the Sierra Nevada montane zone, alternative A would continue providing direction under the current forest plan components. It would continue applying the three strategic wildfire management zones. As a result, due to limited resources, limited operating conditions for prescribed burning and other restrictions, and higher priority setting for the two (Wildland-urban Intermix Defense and Wildland-urban Intermix Threat) of the three management zones, benefits in the form of restoration efforts to the Sierra Nevada montane zone is limited to developed areas and near communities primarily.

When reviewing the historical management practices and changing environmental conditions (such as fire exclusion, vegetation management practices, and sheep grazing), the Sierra Nevada montane zone has also been affected, as have other ecological zones. Areas of forest have become dense or habitats fragmented over landscapes. Tree mortality in this zone is likely at the upper end of its natural range of variability due to drought and other stressors due to climate change. The existing forest plan (alternative A) describes the need to address forest stand density to reduce the risk of trees dying due to stresses related to prolonged droughts. However, the single species specific habitat management direction along with restrictions on prescribed fire within riparian conservation areas and critical aquatic refuges, limits the amount of treatment that can occur within the “general fire management zone” that overlaps with the majority of the Sierra Nevada montane zone.

Common to alternative B, B-modified and D is the development of four strategic fire management zones providing for more options on managing the landscape, including managing fires for resource benefits within zones containing communities, if safe to do so and the conditions are appropriate. This has the potential to benefit species associated with this ecological zone. Alternative B also identified four strategic fire management zones and is similar to alternatives B-modified and D, however, the changes to alternative B-modified and D are mostly in the low elevation sagebrush (moving them to the general protection zone rather than restoration zone) to protect sagebrush habitat from negative fire effects. Alternative C identifies three strategic fire management zones and like the other plan revision alternatives, provides management more options to use managing wildfires for resource benefits in more zones and acres if safe to do so, and therefore should benefit Sierra Nevada montane zone. All plan revision alternatives will be more beneficial and an improvement over alternative A when addressing the restoration and protection of habitat associated with species of conservation concern within the Sierra Nevada montane zone.

Eastside Shrublands and Woodlands Ecosystem Type (Sagebrush, Pinyon-Juniper, Mountain Mahogany and Xeric Shrub and Blackbrush)

Of these ecosystem types, sagebrush and pinyon-juniper cover the most area and are the primary habitats that support at-risk terrestrial wildlife species. There is analysis of eastside arid shrublands and woodlands, especially sagebrush, pinyon-juniper and eastside Jeffrey pine vegetation in the “Terrestrial Vegetation Ecology” section. This analysis builds upon that analysis and emphasizes wildlife habitat and species requirement aspects.

Habitat condition for at-risk terrestrial wildlife species in this zone would be relatively unchanged by management activities due to limited proposed treatments. Alternative A proposes the least amount of restoration of all alternatives. Treatments to reduce invading pinyon in sagebrush would occur focused primarily on sage-grouse habitat, but not at an increased pace as under alternatives B, B-modified, C, and D. this alternative is the least able to prepare the landscape to adapt to changing climate conditions. The landscape under this alternative would continue to have a low resilience to large high-intensity wildfire. The amount of habitat could be reduced more than under any other alternative due to habitat type conversion from increases in cheatgrass, loss of quality habitat due to the spread of pinyon and Jeffrey pine into sagebrush habitat, and the increasing risk of large high-intensity wildfires.

Alternative B would increase restoration levels compared to alternative A but would still treat relatively little of the woodland habitat in this zone. Eastside Jeffrey pine habitats are the most outside of the natural range of variation and at the greatest risk to stressors and, therefore would have increases in treatment. This alternative proposes to treat more habitat in this zone (including sagebrush and pinyon-juniper) than alternative A, focused on restoration of sage-grouse habitat and areas around communities at risk. There would be restoration of riparian areas, most of which would occur in this area on the Inyo National Forest. There would be an increase in the area treated to reduce nonnative invasive plants. There are specific goals and management approaches to increase emphasis on cooperation with adjacent landowners and other interested collaborators in managing habitat. Management approaches include the following:

> Continue coordination and communication with the California Department of Fish and Wildlife, Nevada Department of Wildlife and the U.S. Fish and Wildlife Service during project development for all projects occurring within sage-grouse habitat.
>
> Coordinate with research and other organizations to evaluate the potential effects of climate change on the spread of invasive, nonnative species.

Habitat condition for at-risk terrestrial wildlife species is more likely to improve under alternatives B and B modified and risk of habitat loss from large-scale disturbances is more likely to be less than under alternative A. These alternatives have clear desired conditions for the resiliency, structural diversity, recruitment, functioning, and connectivity of these habitats. These alternatives also take a landscape-level approach to restoration that would translate into large-scale improvements to habitat condition, including connectivity. The composition and structure of vegetation in restored areas in this zone would likely move from low similarity to desired conditions under alternative A to low-moderate similarity to desired conditions in restored areas under this alternative as described in the “Terrestrial Vegetation Ecology” section. Encroaching pinyon and Jeffrey pine would be more effectively removed from large zones of sagebrush. Although the use of prescribed fire would be somewhat limited (although not as limited as in alternative A), this restoration technique would move the structure of these habitats toward the desired conditions. There are specific standards and guidelines to guide restoration project design to enhance or limit impacts to wildlife habitat, especially for sage-grouse and other at-risk species.

Where these habitats occur in wilderness and support at-risk terrestrial wildlife species, the restoration approach proposed under alternatives B and B-modified would be better positioned to use managed wildfire to restore habitat condition (see “Fire Management” section). Most wilderness areas would be in the wildfire maintenance zone where managing wildfires can safely be used to meet resource objectives is emphasized. This alternative is not expected to have as many severe and large, high-intensity fires like those predicted under alternative A (see “Fire Trends” section), which can completely remove this habitat from the landscape. Unlike alternative A, the management approach under alternatives B and B-modified move the landscape toward to a moderate resilience to large high-intensity fire and better positions the vegetation to adapt to changing climate conditions. Alternative B-modified would have a slightly greater beneficial effect to this ecosystem because it would allow for greater flexibility in using prescribed fire in critical aquatic refuges and riparian conservation areas, and would implement restoration on a conservation watershed scale in areas of this ecosystem identified as conservation watersheds.

Although short-term effects to habitat condition could occur due to the increased pace and scale of restoration and more intensive management tools (such as mechanical equipment), these effects would be site and project-specific and cannot be fully assessed at this programmatic level. At the programmatic level of the proposed plan, the long-term benefit to habitat condition and reduction in potential for habitat loss under this alternative is expected to outweigh the potential for short-term effects.

Alternative C emphasizes the management of fire, both the active use in prescribed burning at greater landscape scales as well as through managing wildfires to meet resource objectives. However, alternative C proposes to treat far fewer acres than alternatives B and B-modified, especially in this zone. The exception is that restoration of sagebrush habitats important for sage-grouse would be slightly higher than alternatives B and B-modified. There is 3 percent more sagebrush and pinyon-juniper habitat in recommended wilderness in this alternative relative to B and B-modified.

This alternative is more limited in the use of mechanical equipment that can effectively target specific trees for removal and help move vegetation toward the desired conditions. Therefore, although the potential for short-term effects related to implementation could be less under this alternative than under alternatives B, B-modified and D, the long-term condition of many pinyon-juniper habitats that support a variety of at-risk terrestrial wildlife species would continue to trend away from desired conditions for structure, composition, function, and connectivity over time while conditions of sagebrush habitats would improve similar to alternatives B and B-modified.

The forested habitat would be more vulnerable than alternatives B and B-modified to climate change and large high-intensity fire that can completely remove large areas of this habitat. Invasive species and encroaching pinyon and Jeffrey pine would continue to threaten sagebrush habitat where treatments are limited by restricting harvest to only smaller diameter trees.

In alternative D, benefits to habitat quantity and condition including structure, composition, and resilience to climate change and large high-intensity wildfire, and potential for short-term effects would be the same as those described for alternative B. This alternative proposes to treat about the same, or slightly more habitat in this zone than alternative. However, this habitat already faces threats due to invasive species (cheatgrass) and this alternative has the greatest risk of spreading invasive species due to more acres treated and more mechanical treatments.

Cave, Cave-like, and Cliff Habitats

The amount of cliff, cave, and cave-like habitat is not expected to change under any alternative because management activities would not substantially affect cliff, cave, or cave-like structures. Structures such as adits or buildings that support some cave-associated species could be altered by project-level decisions but this potential action would not differ by alternative and is beyond the scope of this programmatic analysis. The following species are supported by cave, cave-like, or cliff habitat:

- Pseudoscorpions are strongly associated with caves
- Although for the final environmental impact statement no bat species met the criteria to be identified as species of conservation concern, public comments supported retaining plan guidance for bats given their unique habitat requirements and sensitivity to diseases.

Under the current forest plan there are no specific plan components to address caves, cave-like, and cliff habitats. Projects that effect sensitive species are evaluated and mitigations incorporated when needed. Although there is no specific plan direction, many caves and abandoned mines have been gated or closed to the public through project-level decisions to provide for public safety or to prevent disturbance to wildlife.

Under alternatives B, B-modified, C, and D the forest plan recognizes the need to protect caves through establishing direction for "Special Habitats," which includes caves. A desired condition for special habitats recognizes the need to provide appropriate microclimates within caves and a standard ensures that maintenance and enhancement needs for special habitats are incorporated into project design and implementation. When restoration or action is needed in special habitats that contain at-risk species, the intent is to give them a management priority.

In addition, to protect bats, alternatives B, C, and D protect bat hibernacula or maternity colonies by installing bat gates when there is adverse disturbance from recreation, management or other activities. Based upon public comments, alternative B-modified clarifies the plan guidance protecting bat hibernacula or maternity sites by considering either bat gates or restricting access by other means and adds plan guidance to work with state and federal agencies and other partners to provide education materials focused on awareness and prevention of spread of diseases like white-nose disease to caves on the forest.

Vegetation management, prescribed fire, and managed wildfire are not anticipated to change the quantity of cave or cliff conditions in any alternative since these habitats are generally not vegetated. The quality of caves and cave-like structures for wildlife can be affected during vegetation management activities if nearby vegetation removal alters microclimate conditions inside these habitats. Impacts could be either positive or negative depending upon how nearby vegetation affects microclimates, especially related to airflow or waterflow within caves or adits. Prolonged smoke exposure from prescribed fire and unmanaged and managed wildfire could have a short-term impact, particularly to adits and above ground cave-like structures which could disturb or displace wildlife. Reducing fuels through treatments and restoring fire regimes could also reduce smoke impacts to caves and cave-like structures from future wildfires, which would reduce impacts to wildlife. There would be more vegetation management under alternatives B, B-modified and D than under the current condition in alternatives A and C. There would be more prescribed burning and wildfires managed to meet resource objectives under all plan revision alternatives. However, these site-specific activities would be evaluated at the project-level where measures to mitigate adverse impacts would be considered and incorporated into project design.

Aquatic Habitat (Meadows, Lakes and Ponds, Riparian Vegetation)

All alternatives would retain direction for riparian conservation areas that would protect aquatic habitat, including habitat that supports at-risk terrestrial wildlife species. All alternatives would continue to implement priority watershed restoration as funding permits. All alternatives would allow hand treatments in aquatic habitat. The following species are supported by aquatic habitat and/or specific aquatic habitat elements:

- Black toad is associated with springs and seeps.
- California golden trout is found in streams and rivers.
- Invertebrates (butterflies) are associated with meadows, and vegetation around lakes and ponds.
- Aquatic invertebrates such as the Western pearl shell, Owen’s Valley springsnail, and Wong’s springsnail are associated with riparian systems such as springs and seeps, or rivers and streams.
- Willow flycatcher depends on dense willow thickets in large wet meadows.
- Greater sage-grouse in the bi-state distinct population segment depend on wet meadows and riparian areas as foraging habitat for young.
- Sierra marten use riparian stringers within mature forests.
- Bald eagles roost and nest near and forage in large waterbodies.
- Great gray owls forage in meadows.

Under alternative A, current forest plan direction would continue. The current plan generally limits disturbance and impacts within riparian conservation areas and critical aquatic refuges through prescriptive direction, but does not prohibit activities. Because alternative A does not consider the change in temperature and precipitation related to climate change and other climate stressors to aquatic systems which may result in more conifer encroachment, invasive species, and wildfires, risks to the amount and condition of aquatic habitat are greatest relative to the other alternatives.

Although managed wildfire is considered a tool and encourages the restoration of fire to the ecosystem using prescribed fire and allowing management of some wildfires when they can meet resource objectives as defined by the forest plan, under this alternative, the unnaturally dense conditions of riparian habitats and adjacent uplands can makes it challenging to meet the objectives, without prior vegetation treatments.

The number of meadows and acres of riparian habitat maintained or improved is the least in alternative A. Since high elevation meadows and riparian areas (upper montane, subalpine, and alpine) are generally not prioritized for maintenance or improvement under any alternative, the focus on wildland-urban intermix treatments under alternative A makes it even more difficult to treat this vegetation zone. The habitat in these higher elevation areas are not as far outside of the natural range of variation, and therefore stressors that could be alleviated by vegetation treatment are not as crucial as those lower elevation habitats. Much of these high elevation zones are in designated wilderness or have limited access.

In alternative B, most of the riparian, meadow, and aquatic plan components are the same as in alternative A (see chapter 2). However, there are more specific ecological desired conditions and specific objectives to restore riparian and aquatic ecosystems.

Direction is modified in alternatives B and B-modified to allow prescribed burn ignitions and, where necessary, mechanical and hand treatments to restore ecological integrity and improve resilience of riparian ecosystems to fire, drought, and climate change. Riparian and meadow vegetation restoration under this alternative would be for the purpose of moving vegetation toward the desired conditions and would be intended primarily to restore native species composition, heterogeneity, resilience, and reduce the ingrowth of conifers where appropriate.

Alternative B proposes to add one critical aquatic refuge relative to alternatives A and D. This additional refuge was created to protect the black toad on the east side of the White Mountains. This additional critical aquatic refuge will provide slightly greater protection of riparian habitat within that area.

The management approach under alternative B proposes to maintain, enhance, or improve more acres of riparian habitat and more meadows than alternative A and with a greater variety of restoration tools (mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives). Alternative B is expected to have about the same acreage of riparian and meadow habitat as alternative B-modified, but the addition of conservation watersheds should help restore larger landscape areas. This larger watershed approach should allow for greater indirect improvement in riparian habitat than the other alternatives, because it would improve watershed processes and habitats for many species that may interact, rather than focus on one species.

Prescribed fire and wildfire managed primarily for resource benefit would improve the condition, vigor and health of most native riparian plants that support forage and nesting habitat for a variety of species. Increased structural diversity of these habitats would favor use by a variety of species strongly associated with complex understory and overstory. Increased fire would result in increased sprouting, health, condition, and vigor of hardwood and understory plants, including host plants for a variety of invertebrates. The trend in composition and structural heterogeneity of native species would increase.

Alternative B-modified is anticipated to improve habitat condition at the landscape scale. Riparian habitats would be treated where they are adjacent to upland habitat that is being restored. The synergistic benefit of restoring neighboring riparian and upland habitats can benefit species that use both habitat types to meet life history requirements. In addition, treating these features in the upland and riparian areas can reduce the ingrowth of conifers and invasive species in both these habitats. Further, conservation watersheds would focus on watersheds in need of some landscape scale restoration, and should improve a holistic ecosystem rather than habitat for a single species as is more the focus with critical aquatic refuges in the other alternatives.

Alternatives B and B-modified would move the landscape from a low to a moderate resilience to large high-intensity wildfire (See the "Terrestrial Ecosystem Processes and Functions" section). Warming trends and drought conditions can cause a variety of stressors for many habitats, but particularly aquatic habitats. These habitats have suffered directly from drought and warming conditions but also indirectly by the ability of many invasive species to move into aquatic habitats, outcompeting native species for space, water, sunlight, and nutrients that support many terrestrial wildlife species.

Although treatments are expected to have a variety of long-term benefits, there is potential for short-term effects during and immediately following project implementation. In general, manipulating more habitat under this alternative as opposed to alternative A would translate into more potential for disturbance to individuals and temporary disturbance to habitat condition from the use of equipment and fire, until the habitat recovers. Overall, over the long term, these restoration actions are anticipated to provide more productive site conditions, which would result in improved habitat conditions.

Alternatives B and B-modified include an increased emphasis on partnerships and stewardship funding to accomplish meadow restoration. In the montane zone, much of the aquatic habitat is threatened by large fires with high-severity effects, overcrowding by conifers, homogeneity of vegetation structure and composition, and the continued spread of invasive species. These areas would experience more treatments than other zones, although treatment intensity would be relatively light. In the upper elevations like upper montane, subalpine, and alpine zones, treatments of upland habitat are not prioritized and therefore aquatic habitat would receive fewer treatments.

Alternative C proposes to designate 8 additional critical aquatic refuges on the Inyo National Forest. Therefore, there would be more emphasis on protection of aquatic habitat in these designated areas than the other alternatives. These additional critical aquatic refuges would not provide a landscape scale restoration emphasis, but would emphasis one species each. This may not provide as much habitat resilience for riparian habitat as alternative B-modified, which designates conservation watersheds and eliminates critical aquatic refuges.

However, the use of prescribed fire under alternative C to reduce stand density and create more open, safe burning conditions would be constrained because of the species-specific protections and inability to prepare the landscape with mechanical treatments first. This alternative does not treat at the landscape scale, which would make patches more vulnerable to a variety of stressors adjacent to this habitat as well as upstream and downstream of this habitat, including loss of habitat elements from wildfire, ingrowth of conifers in adjacent upland units, and spread of invasive species. Because this alternative has a lower ability than alternative B to move the landscape toward resilience to climate change and large high-intensity wildfire, aquatic habitat under this alternative would be at a greater risk to degradation from unabated stressors and large-scale disturbances. The long-term effects may be more negative if fire destroys vegetation that supports specialized species (like butterflies), and the availability of nest trees and shrubs. Fewer landscape treatments may require more suppression of wildfires, which could allow conifers to grow into meadows.

Alternative C includes the same increased emphasis on partnerships as alternatives B and D. However, there may be fewer opportunities for stewardship funding under this alternative due to the fewer acres of upland vegetation to be treated. Funding of meadow maintenance, enhancement, or improvement may be a substantial constraint under this alternative.

Although there is less potential for short term, implementation-related impacts under this alternative, the long-term negative impacts on habitat conditions because of the treatment limitations and lack of a landscape scale approach under this alternative could be greater than under the other alternatives.

By increasing the amount of ecological restoration overall under this alternative, more opportunities exist for implementing watershed restoration projects than any other alternative. Alternative D would maintain, enhance or improve the same number of meadows as alternatives A, B, and B-modified and about half of the meadows as alternative C, move the landscape to a greater resiliency to climate change, and more rapidly achieve improvements to structure, composition, and heterogeneity than any other alternative.

Similar to the other plan revision alternatives, alternative D also includes an increased emphasis on partnerships. Therefore, this alternative (followed by B-modified) should have the most funding to improve aquatic habitat condition and at a landscape scale.

The tradeoff of increased pace and scale of restoration, including the use of mechanical equipment, is the potential for more short-term impacts than any other alternative. For example, alternative D has the greatest potential to spread invasive species as a result of more acres treated. As with all alternatives, the potential short-term impacts of treatment proposed under this alternative would be evaluated on a project-specific basis as projects are developed.

Sierra Nevada Bighorn Sheep (Endangered Species)

Consequences Common to All Alternatives

Livestock grazing management would not vary by alternative, and therefore effects to Sierra Nevada bighorn sheep from livestock grazing would remain very minor under all alternatives.

Although there is no goat grazing within authorized livestock grazing allotments, recreational pack goat use is currently allowed but actual use is believed to be very low. Although pack goats could potentially transmit disease to sheep because they can carry some of the same diseases, there are no records of pack goat contact with bighorn sheep. Prescribed fires are not likely to occur within wilderness areas, where most of the critical habitat occurs but could occur in portions of the winter range outside of designated wilderness areas. The Sierra Nevada bighorn sheep 5-Year Review (United States Department of the Interior 2008b) identified a concern for degraded vegetation condition in the winter range due in part to a history of fire suppression. It is thought that reductions in winter range habitat quality, possibly amplified by other factors like mountain lion predation, may limit population growth and increase mortality for Sierra Nevada bighorn sheep. This may be especially true in harsher winters when bighorn sheep remain in high elevation ranges instead of migrating to lower elevation winter range. To date, although limited prescribed burning to improve conditions within bighorn sheep winter range has occurred, a list of specific areas for prescribed burning or restoring fire to benefit bighorn sheep has not been identified by the Forest Service, U.S. Fish and Wildlife Service, or California Department of Fish and Wildlife.

The California Department of Fish and Wildlife conducts actions to help restore the Sierra Nevada bighorn sheep population throughout its range, guided by the 2007 Recovery Plan. They are expected to continue to conduct population surveys, evaluate and monitor mortality in bighorn sheep, and evaluate and implement translocation efforts as determined necessary to meet recovery plan distribution and population criteria. It is expected they will also continue to evaluate and oversee the management of mountain lions that are affecting species recovery.

Consequences Specific to Alternative A

Alternative A includes direction for bighorn sheep that applies to Sierra Nevada bighorn sheep but does not clearly separate the direction into distinct plan components. The direction applies to both the Sierra Nevada bighorn sheep and to Nelson desert bighorn sheep. Direction exists in the existing plan to limit disease transmission from domestic livestock and to maintain and expand bighorn sheep occupancy where feasible. Direction also exists in designated wilderness areas and mountain sheep habitat to reduce conflicts with recreation trails and other management activities such as locations of roads, helispots, hang gliding, and minerals operations. Most of this direction is functionally similar to the plan direction of the other alternatives.

The current forest plan only defines fire management zones around communities. No specific forest plan direction exists to guide fire management in the critical habitat which is primarily located in designated wilderness and remote alpine and subalpine habitats away from communities. Within designated wilderness the use of mechanized transport and motorized equipment is generally prohibited with exceptions. When fires occur within or near critical habitats or occupied habitats, fire management decisions are guided by agency policies and procedures where naturally ignited wildfires are considered for management to meet resource objectives on a case-by-case basis. Since forest plan resource objectives for wildfire management are only general in nature, many wildfires continue to be suppressed, slowing the restoration of fire as an ecosystem function to forest landscapes. There could be more immediate disturbance by firefighting actions under this alternative when fire management is focused on suppression. Continuing to suppress wildfires also allows vegetation to continue to become denser which increases predator hiding cover and lowers habitat use by bighorn sheep or could contribute to higher rates of predation by mountain lions.

There is a concern for disease spread from domestic goats to bighorn sheep. Although there are no livestock grazing allotments that permit domestic goats, there is currently a limited amount of recreational pack goat use that occurs. Since recreational pack goats are typically under close control of their handlers, the risk of contact with bighorn sheep is likely to be low. Alternative A does not have specific plan direction to address this but the forest would typically coordinate and cooperate with the U.S. Fish and Wildlife Service or California Department of Fish and Game to address known site-specific problems if they were identified.

Consequences Specific to Alternatives B, B-modified, C, and D

As Sierra Nevada bighorn sheep recover, the alternatives express the intent to manage population expansion areas occupied by bighorn sheep outside of current herd units in order to improve population distribution. The alternatives clarify the desired condition for bighorn sheep habitat to better describe the different seasonal habitat needs and need to provide for movement between the herds. This contributes to a recovery plan task to maintain and enhance integrity of bighorn sheep habitat (USDI Fish and Wildlife Service 2007).

Wildfires will continue to burn across the national forest and they will continue to be actively managed using a range of fire management responses in all alternatives. Since these alternatives more clearly define resource objectives for wildfire management, it is expected that more naturally ignited wildfires would be managed to restore fire to the landscape instead of being immediately suppressed. This is particularly expected in designated wilderness and remote areas, which includes most of the critical habitats for this species. Over time, if more wildfires are managed to restore the patchy distribution of fires, it’s expected that the opportunities to manage more wildfires will increase as new fire ignitions have areas with lower fuels surrounding them. To the extent this occurs, the magnitude and intensity of firefighters needed to manage these fires may decrease, which would lower the exposure to disturbance. Restoring a patchy distribution of fires would also help restore more open vegetation conditions which would decrease predator hiding cover and could improve habitat use by bighorn sheep.

Under the current plan and direction from the Sierra Nevada Bighorn Sheep Recovery Plan, the risk of disease contact from domestic sheep and goats has been minimized. However, these alternatives strengthen that effort by also including direction that would increase the awareness of the risk of disease spread and importance of notifying officials when trespass livestock are discovered within the Sierra Nevada bighorn sheep range. The alternatives include an emphasis on cooperating with partners and private landowners to encourage resource protection across ownership boundaries and guidance to help ensure state and federal agencies are aware of the procedures to report trespass livestock to the Inyo. A desired condition supports continuing to develop and distribute appropriate educational material to local residents and visitors about Sierra Nevada bighorn sheep and the actions needed to protect them which supports a recovery plan task (USDI Fish and Wildlife Service 2007) related to public education.

Compared to alternative A, all plan revision alternatives strengthen the cooperative relationship with the California Department of Fish and Wildlife to manage Sierra Nevada bighorn sheep populations by containing a goal to work with State agencies to restore and maintain essential habitat for at-risk species and implement other recovery actions according to species recovery plans. This would facilitate cooperation and support if those activities occur on National Forest System lands to support the desired condition that activities are designed to maintain or enhance self-sustaining populations of at-risk species within the inherent capabilities of the plan area by considering the relationship of threats (including site-specific threats) and activities to species survival and reproduction. Supporting these activities will contribute to a recovery plan task to temporarily protect Sierra Nevada bighorn sheep herds from predation losses where needed and could support a recovery plan task to reduce influences of predation on winter habitat selection, if the California Department of Fish and Wildlife determines this action is necessary.

Consequences Specific to Alternative B

Alternative B includes species specific plan direction and plan content for bighorn sheep that describe bighorn sheep habitat, provide guidance to reduce the risk of disease transmission from domestic sheep and goats, and provide guidance to manage disturbance from recreation.

The majority of the Sierra Nevada bighorn sheep habitat and critical habitat is located in the Wildfire Maintenance Zone and Wildfire Restoration Zone. Within these two strategic fire management zones, fires from natural sources such as lightning, would be evaluated to determine if they could be managed with less than a full fire suppression response, considering safety to firefighters and the public and potential positive and negative effects from expected fire behavior to various resources. Fires in the bighorn sheep range are expected to occur infrequently, and are expected to mostly be small in size with mixed severity fire effects given the sparse fuel conditions. Fire intensity is also expected to be highly variable in the subalpine zone with large higher severity fire patches usually limited in size to the matrix of clumpy forest and forested meadows. Fire management may have short-term effects but are expected to have minimal long-term adverse effects on suitable habitat considering the rugged rocky terrain favored by bighorn sheep. In the wildfire maintenance zone, the alternative encourages restoring fire to the landscape by requiring documentation when naturally ignited wildfires are promptly suppressed. Within designated wilderness the alternative includes direction to use minimum impact strategies and tactics unless more direct action is needed for safety and to protect property. The intent is to use spatial support tools, wildfire risk assessments, and decision support systems to determine the appropriate wildfire management strategy. Since the location of designated critical habitat is included in these decision-support systems, the risk of adverse impacts to Sierra Nevada bighorn sheep and critical habitat from wildfire and fire management actions would be lessened. Effects of use of managed wildland fire may have some ephemeral adverse effects, but the desired condition is to restore fire as a natural ecosystem process for the long-term benefit of this species and would be designed to protect or restore vegetation structure and composition that would sustain or improve the ecological conditions needed by the species within critical habitat and improve the condition of forage and cover outside of critical habitats. Overall increasing the amount of fire within the bighorn sheep range would generally be beneficial where it restores more open conditions and increases visibility and reduces hiding cover for predators. Implementing these fire management approaches is expected to increase the likelihood of restoring fire to areas occupied by Sierra Nevada bighorn sheep which will contribute to a recovery plan task to maintain or enhance the integrity of bighorn sheep habitat.

Although specific areas for prescribed burning within the winter range have not been identified, a goal in this alternative is to work with State and Federal wildlife agencies to identify such areas. There could be some disturbance to individual animals from prescribed fire management activities, but any adverse effects from those activities would be evaluated and mitigated during project-level decisionmaking that would require compliance with section 7 of the Endangered Species Act. Increasing the amount of wildfires managed to meet resource objectives and prescribed burning in the winter range would have short-term effects to forage but would be expected to have longer term benefits and would contribute to a recovery plan task to enhance bighorn sheep winter range habitat to increase visibility where appropriate.

Alternative B contains similar plan direction to manage the risk of disease transmission from domestic sheep and goats and consequences would be similar to alternative A.

Consequences Specific to Alternative B-modified

As a result of considering public comments, further clarifications were made to plan direction, particularly clarifying the desired condition for habitat, more clearly addressing the risk of disease transmission from domestic sheep and goats, and better addressing the potential for disturbance from recreation activities.

Although the risk of contact between domestic livestock and bighorn sheep has already been minimized within the areas identified as high risk, the plan direction from alternative B was clarified to support continuing to manage to minimize the risk of contact if conditions change and direction specifically identifies the use of risk assessment methods in evaluating where changes may need to be considered. A desired condition for bighorn sheep habitat addresses this by describing that the risk of disease transmission is reduced to the maximum extent possible. This recognizes that the extent is dependent upon the reliability of risk assessment modeling and therefore risk cannot be completely eliminated. Plan direction also directs that domestic sheep or goat grazing and pack goat use is not allowed in areas where there is a high risk of contact unless the risks of disease spread can be adequately mitigated. This plan direction would guide determining if there was a need to site-specifically evaluate and possibly adjust livestock grazing in specific areas if the risk of contact changes over the life of the forest plan.

In response to public comments, about the risk of disease spread and pack goat use, alternative B-modified includes the intent to coordinate with the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to conduct a risk assessment of pack goat use and develop mitigations strategies to manage the risk of disease transmission, if needed. If upon completion of the risk assessment, risk mitigation actions are needed, plan direction would require that pack goat use not be allowed unless the risks can be mitigated in any areas having high risk of disease transmission. This more clearly contributes to a recovery plan task to prevent contact between bighorn sheep and domestic sheep or goats.

Although not currently known to be a substantial concern, alternative B-modified includes specific direction to evaluate areas and take action when needed where recreation or other disturbance is causing Sierra Nevada bighorn sheep to avoid important habitat areas. This more clearly contributes towards a recovery plan task to investigate and analyze human use patterns relative to habitat use patterns of bighorn sheep and another recovery plan task to manage human use locally where research finds human use is causing bighorn sheep to avoid important habitat, which may compromise survivorship or reproductive success. Although the other alternatives do not specifically address this concern, the consequences are likely not substantially different since alternatives A, B, C, and D also include direction to contribute to the recovery of federally listed species and would likely address the concern in a similar manner.

The consequences of wildfire management and prescribed burning would be similar to those described for alternative B. In alternative B-modified, lower elevation portions of the herd units in the southern recovery unit that contain sagebrush are classified as the general wildfire protection zone instead of the wildfire restoration zone to recognize the sensitivity of sagebrush ecosystems to wildfire. This change would not likely result in a substantial difference in how fires are managed compared to other alternatives because the potential for not meeting resource objectives in sagebrush ecosystems would tend to guide fire management decisions toward fire suppression regardless of the strategic fire management zone classification.

Consequences Specific to Alternative C

The management direction for bighorn sheep and consequences of alternative C would be similar to those described for alternative B-modified regarding the risk of disease spread between Sierra Nevada bighorn sheep and domestic sheep and goats and the management of recreation impacts. Alternative C would have similar emphasis on managing wildfires to meet resource objectives in the wildfire maintenance zone as alternative B-modified, which includes much of the critical habitat in the alpine and subalpine zone. Management within the portions of the general wildfire zone that overlap with critical habitats would also be managed similarly to alternative B-modified because most of this area is in designated wilderness or in inventoried roadless areas where on-the-ground management is limited by requirements for those management areas and wouldn't vary substantially by alternative. Alternative C has an emphasis on prescribed burning so there would be more opportunity to restore fire to the portions of the lower elevation winter range compared to alternatives A, B, and B-modified and similar opportunity compared to alternative D. Prescribed burning in the winter range would improve forage conditions and reduce vegetation density to increase openness and visibility to decrease predation risk. To the extent that Sierra Nevada bighorn sheep begin to reuse winter range, it could reduce winter mortality in harsh winters compared to individuals that remain in the higher elevation portions of the range, although it is thought that mountain lion predation was a cause of the range shift in the past (Wehausen 1996).

Consequences Specific to Alternative D

The consequences of alternative D overall would be similar to those described for alternative B-modified as the management of disease risk, management of recreation conflicts, and the strategic wildfire management zones and direction within them would be the same. Under alternative D, there would be more emphasis on increasing the amount of vegetation restoration and prescribed burning, which could result in slightly more opportunity to restore fire to the portions of the lower elevation winter range compared to alternatives A, B, and B-modified and may be similar in opportunity to alternative C. The benefits and consequences of restoring fire to the winter range would be similar to alternative C.

Nelson Desert Bighorn Sheep

Effects of all alternatives to Nelson bighorn sheep will be similar to Sierra Nevada bighorn sheep as it relates to managing for the outbreak or continuation of disease contact or spread. Contact with disease or spread of it from infected domestic animals such as goats or sheep may occur off or on the national forest. The Inyo National Forest is not responsible for disease spread management outside the national forest. The risks of disease from recreational pack animals such as goats on the Inyo are very low due to very low probability of direct contact between both. The Inyo National Forest limits this threat by restricting goat and sheep use in areas of the White Mountains on national forest lands that overlap with bighorn sheep. This is accomplished through the permitting process.

Alternative A includes direction for bighorn sheep that applies to Sierra Nevada bighorn sheep but does not clearly separate the direction into distinct plan components. The effects are similar to those for Sierra Nevada bighorn sheep. See “Consequences Specific to Alternative A” for Sierra Nevada bighorn sheep.

Although the current plan designates three fire management zones on the Inyo National Forest, two of these are focused on wildland-urban intermix, and the third zone identifies the remainder of the national forest. This area encompasses other land allocations but home range core areas, old forest emphasis areas, general forest, and wilderness allocations predominate. Fuel treatments in the general forest areas, are designed to support fuel treatments in the Wildland-urban Intermix Threat Zone, to protect sensitive habitats, and re-introduce fire to fire-dependent ecosystems. There is little direct management of subalpine and alpine vegetation in alternative A. Most of this vegetation is in wilderness areas, where natural processes are the dominate management approach.

Habitats for at-risk species support self-sustaining populations within the inherent capabilities of the plan area. Ecological conditions provide habitat conditions that: contribute to the survival, recovery, and delisting of species under the Endangered Species Act; preclude the need for listing new species; improve conditions for species of conservation concern, including addressing threats (minimal impacts from diseases); and sustain both common and uncommon native species.

Consequences common to alternatives B, B-modified, C, and D are similar to each other in that they provide for opportunities for more overall restoration acres than alternative A. Restoration in the alpine zones habitat types would benefit this species to reduce the effects of climate change and predation. The difference in acres within the wildfire maintenance zone is approximately 30,000 acres between any one of them. However, benefits to bighorn sheep will primarily result from natural fires managed for resource objectives that maintain alpine habitat including meadows, and reduce the spread of tree and shrub cover.

Effects from alternative B are similar as described above in "Consequences Specific to Alternatives B, B-modified, C, and D" for Nelson's bighorn sheep. Alternatives B and B-modified are similar with the modified version clarifying direction related to disease risk from domestic livestock to continue to use a risk assessment approach, added direction to evaluate recreation impacts where potential conflicts to Sierra Nevada bighorn sheep are identified.

In both alternatives B and B-modified the proposed wilderness additions of approximately 37,029 acres would have no benefits to this species. The areas proposed for addition are not suitable for this species. Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

Although consequences of alternatives B and B-modified identify new wildfire management zones, this species occurs primarily at the high elevations that overlaps with the proposed wildfire maintenance zone. This zone include the wilderness areas, where mechanical treatments are not allowed. However, wildfires that meet resource objectives occurring in this zone could be very beneficial to this species by reducing the amount of tree and shrub cover that otherwise could be used by predators.

Pacific Fisher

Pacific fisher have been detected (from systematic sample units) on the Inyo National Forest on a small forested portion of the Kern Plateau. However, detections are relatively few, and it is not likely that an independent viable population exists within the national forest boundary. Forests containing old forest characteristics (dense vegetation and canopy cover, snags, cavities, larger trees, and large down woody debris) in coniferous and mixed pine-oak forests provide the ecological conditions believed to be important to support the persistence of the species.

Alternative A provides plan direction for minimizing disturbance and activities near den sites for forest carnivores, which include fisher. However, it is difficult to identify den sites because the species is secretive and uses multiple den sites within a breeding season. Additional direction for the southern Sierra fisher conservation area does not apply to the Inyo National Forest since this area is mapped to stop at the national forest boundary.

Plan direction for fisher is improved under all of the plan revision alternatives as compared to alternative A by providing plan direction to manage identified habitat within fisher Core 1 and plan direction that will guide projects to conserve key habitat characteristics such as multi-storied canopies, understory vegetation, and woody debris, during the planning and implementation of projects. Under alternatives B and B-modified, none of the recommended wilderness additions are within the Sierra Nevada montane zone that might provide habitat for this species. Under alternative C, only the Golden Trout and a small portion of the South Sierra Wilderness East 2 additions are within the Sierra Nevada montane zone that might benefit this species by limiting future development. Within recommended wilderness areas, options for managing habitat using mechanized equipment or other techniques that would not maintain wilderness character would not be allowed. Since most of the areas recommended for wilderness are currently managed as inventoried roadless areas or have limited access, there may be little difference in habitat restoration opportunity for this species between the alternatives, although restoration where it could occur might be more limited in alternative C that has a preference to using prescribed fire instead of mechanical treatments to manage vegetation and fuels.

Since most of the habitat for Pacific fisher is within wilderness areas, inventoried roadless areas, and remote areas, habitats will be most influenced by how wildfires are managed over time. As described in the general consequences above, management of wildfires to meet resource objectives would be clearer under the plan revision alternatives compared to alternative A because it uses a risk-based approach and includes desired conditions and other plan direction to encourage restoring fire to the landscape when safe to do so. The extent that wildfires can be restored within the Sierra Nevada montane zone would increase resilience of fisher habitat.

Although management approaches for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

Sierra Marten

Alternative A provides plan direction for minimizing disturbance and activities near den sites for forest carnivores, which include marten. However, it is difficult to identify den sites because the species is secretive and uses multiple den sites within a breeding season. Plan direction for marten is improved under all of the plan revision alternatives as compared to alternative A by providing plan direction to manage identified marten core habitat and plan direction that will guide projects to conserve key habitat characteristics such as multi-storied canopies, understory vegetation, and woody debris, during the planning and implementation of projects.

Under alternatives B and B-modified none of the recommended wilderness additions are within the Sierra Nevada montane zone that might provide habitat for this species. Under alternative C only the Ansel Adams, Golden Trout, and South Sierra Wilderness East 2 additions are within the Sierra Nevada montane zone that might benefit this species by limiting future development. Within recommended wilderness areas, options for managing habitat using mechanized equipment or other techniques that would not maintain wilderness character would not be allowed. Since most of the areas recommended for wilderness are currently managed as inventoried roadless areas or have limited access, there may be little difference in habitat restoration opportunity for this species between the alternatives, although restoration where it could occur might be more limited in alternative C that has a preference to using prescribed fire instead of mechanical treatments to manage vegetation and fuels.

Since most of the habitat for Sierra marten is within wilderness areas, inventoried roadless areas, and remote areas, habitats will be most influenced by how wildfires are managed over time. As described in the general consequences above, management of wildfires to meet resource objectives would be clearer under the plan revision alternatives compared to alternative A because it uses a risk-based approach and includes desired conditions and other plan direction to encourage restoring fire to the landscape when safe to do so. The extent that wildfires can be restored within the Sierra Nevada montane zone would increase resilience of Sierra marten habitat.

Although management approaches for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

Bald Eagle

Bald eagle potential nesting habitat on the Inyo National Forest is somewhat limited. Nevertheless, when comparing the habitat within the ecological zones important for bald eagle survival and persistence among alternatives, alternative B, B-modified, C, and D provide plan direction for desired conditions, standards, objectives, and guidelines for conserving key habitat characteristics during the planning and implementation of projects on the ground. Alternative A also provides plan direction for minimizing impacts to bald eagle. Plan direction for bald eagle is improved under all of the plan revision alternatives over alternative A. Alternative B-modified is fundamentally alternative B with modifications which include replacing critical aquatic refuges with conservation watersheds. This modification provides for the long-term maintenance and restoration of functioning watersheds providing habitat for the persistence of species of conservation concern. However, alternatives A, B, C, and D propose critical aquatic refuges and not the conservation watershed approach that alternative B-modified does.

Alternatives B and B-modified are similar regarding the addition of proposed designated wilderness in that both propose the same amount (37,029 acres) and locations of the areas, compared to alternative C, which is proposing approximately 315,531 acres. Proposed new wilderness areas consisting of eagle habitat in proximity to larger lakes and rivers within the Sierra Nevada montane ecological zone would benefit this species if the habitat (primarily mixed conifer and Jeffrey pine forests of the Sierra Nevada montane zone) can be maintained and/or restored over time. Once designated wilderness, options for managing habitat using equipment or other techniques not meeting wilderness objectives may be problematic for management of this species within these areas. Alternatives A and D do not propose new wilderness areas, and therefore, forest plan direction would continue as described in the first paragraph above for bald eagle.

Management of wildfires as addressed in the range of alternatives, would result in alternative B, B-modified, C, and D benefiting bald eagle the most as compared to alternative A. Though options of mechanized equipment within wilderness is not likely for bald eagle habitat management purposes, managing wildfires for resource objectives will provide for benefits to this species. However, alternative C is limited in the use of mechanical treatments towards small-diameter trees (outside wilderness). Furthermore, as described above related to the comparisons of wilderness additions, although the most acres proposed for new wilderness is within alternative C, and although managing wildfires for resources objectives is supportive under this alternative, the option of treating small-diameter trees in wilderness will not be an option.

When comparing the alternatives as it relates to recreation, which is perhaps the biggest immediate risk factor affecting bald eagle on the Inyo National Forest, alternative B-modified is the most beneficial as a result of proposing an adaptive and integrated approach to designing and managing recreation infrastructure and managing visitor use and demands. Alternative A provides for the least of amount of recreation management that addresses bald eagle impacts, while alternatives B, C, and D are similar to each other in this regard. When comparing the range of alternatives on how they address threats of persistence to bald eagle as described above, and when looking at other important specific factors such as the loss of mature old forests from fire and disease and insects, climate change impacts, riparian areas, and water quality and quantity, alternative B-modified provides for the greatest opportunities as it relates to maintenance and restoration of principle bald eagle habitat and protection from human disturbance. Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

Bi-state Greater Sage-grouse

All alternatives recognize the need to improve sage-grouse habitats by managing encroaching conifers and managing areas with invasive cheatgrass and their potential spread. Alternative A continues to implement restoration in the Bi-State Action Plan (Bi-State Technical Advisory Committee Nevada and California 2013) as funding allows, but it would result in the lowest restoration treatment rates of greater sage-grouse habitat than any of the other alternatives and therefore would take the longest to achieve desired conditions across many landscapes within the eastside shrublands and woodlands ecosystem type (sagebrush habitat). All plan revision alternatives incorporate some elements of the Bi-State Action Plan (Bi-State Technical Advisory Committee Nevada and California 2013) as species-specific desired conditions and plan components, which will better guide project development to provide for the ecological conditions important to sage-grouse than in alternative A.

The plan revision alternatives include plan direction that limits disturbance at leks, reduces the risk of predation (ensures tall structures near lek habitat are absent or retro-fitted with perch deterring devices), and includes direction to manage livestock grazing activities that could impact sage-grouse. Alternatives B and B-modified establish plan objectives that propose moving a greater amount of sagebrush shrublands towards the desired condition and include a more landscape type of approach so restoration has greater long term benefits to sage-grouse habitat. Alternative C and alternative D both include plan objectives that propose moving more sagebrush habitat towards the desired condition, especially in sage-grouse habitat. However, alternative C would manage some portions of sagebrush habitats in the Glass Mountains area which is proposed as recommended wilderness. This would limit the types of sagebrush habitat restoration that could occur by limiting but not prohibiting mechanized methods and could result in habitat in that area remaining departed from desired conditions. To allow more opportunities for sagebrush habitat restoration, these areas were not included as recommended wilderness areas in alternatives B and B-modified.

Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives would adopt a framework for future management actions with regards to recreation management and resource protection.

The plan revision alternatives also recognize the risk of nonnative invasive plants, such as cheatgrass invasion, that could occur with ground disturbing restoration actions and provides plan direction to minimize the risk of spread and to prioritize invasive species treatments where containment or eradication is possible. While many actions currently occur to manage invasive species that affect sage-grouse under alternative A, the focused plan direction (plan revision alternatives) is expected to result in more active treatment and a greater benefit to sage-grouse habitats.

The use of managed wildfires to meet resource objectives is similar between the plan revision alternatives. Strategic fire management zones are identified based upon the risks and benefits to highly valued resources and assets expected from future wildfires. In alternative B, much of the sagebrush habitats that are not in proximity to communities or assets are identified as the wildfire restoration zone, where some wildfires would be expected to be managed to meet resource objectives. However, given the sensitivity of sage-grouse habitats to degraded conditions from wildfire and due to the risk of cheatgrass invasion following wildfire, most fire management actions in sagebrush tends towards taking fire suppression actions. Alternatives B-modified and D reassign areas of low elevation sagebrush to the general wildfire protection zone rather than the wildfire restoration zone in order to recognize that fire suppression to protect sagebrush habitat from negative fire effects is the more likely expected outcome. Alternative C uses a different strategic fire management zone approach and most of the sagebrush habitats are in the general wildfire zone where the risks and benefits to resources are mixed and fire management decisions would be variable depending upon local conditions but overall, opportunities to restore fire to the landscape would be favored. Despite the differences in strategic fire management zones between alternatives, since fire management decisions are made site-specifically at the time that wildfires occur and consider local risks and benefits, it's likely that little difference would exist between alternatives and most wildfires that are determined to likely adversely affect sage-grouse habitats would tend towards taking fire suppression actions.

When comparing the range of alternatives on how they address the threats of persistence to greater sage-grouse as described above, and when considering other important specific factors such as the expansion and encroachment of pinyon-juniper and conifers, invasive species, livestock grazing, riparian areas, climate change, and habitat fragmentation alternatives B-modified and D would provide the greatest benefit by encouraging habitat restoration on substantially more acres than under alternative A and having clearer direction to guide fire management decisions to provide the desired ecological condition in sagebrush habitats. Alternative C would restore more habitat than alterative B but some limitations would occur in the sage-grouse habitat that would be managed as recommended wilderness.

California Spotted Owl

California spotted owl have been detected (from surveys) on the Inyo National Forest on the west side of the national forest, in wilderness, and the far south end of the Inyo. However, detections are relatively few, and it is unknown if a viable population exists on the national forest. Stands containing old forest characteristics (dense vegetation and canopy cover, snags, cavities, larger trees and large down woody debris) in coniferous and mixed pine-oak forests provide the ecological conditions believed to be important to support the persistence of the California spotted owl. On the Inyo, these ecological conditions can be found in limited quantities in the Sierra Nevada montane ecological zones that consist of dry mixed conifer, red fir, Jeffrey pine, and lodgepole pine.

California spotted owl is a sensitive species and covered under the direction of the current forest plan components in alternative A. The current direction for this species is primarily designed for forest conditions and forest management activities typical of the west-side of the Sierra Nevada and require establishing 300-acre protected activity centers and 1,000 acre home range core areas around the best available habitat. Plan direction also guides projects to limit disturbance, maintain moderate to dense canopy cover, and limit the extent of habitat change when designing fuels and vegetation projects in spotted owl habitat. Proposed projects that may impact this species are evaluated site-specifically in a biological evaluation and projects are designed to minimize adverse impacts. In the plan revision alternatives, the California spotted owl is managed as a species of conservation concern. In alternative C, direction for protected activity centers remains similar to alternative A, but direction for home range core areas is replaced with direction for a 1,000-acre circular territory surrounding the activity center. Additional direction is provided to manage the larger home range for each territory. In alternatives B, B-modified and D, the direction for establishing and managing protected activity centers and spotted owl territories remains similar to alternative A but direction to manage for large home ranges is not included because of the limited extent of habitat in the plan area and because the habitats around the reported locations are somewhat atypical of the lower and mid-elevation west-side forests, which are the basis for most of the scientific studies and habitat descriptions.

Forest management has been identified as a continuing threat to spotted owl persistence in the Sierra Nevada (Gutierrez, Manley, and Stine 2016). Effects of vegetation treatments on persistence of spotted owl across its range are complex and not well understood. Treatments that: result in a reduction of canopy cover to less than 40 percent, remove surface and ladder fuels, and simplify vertical and horizontal stand structure with an increase in regularly spaced trees may have negative impacts on spotted owls (Tempel, Peery, and Gutierrez 2014; Stephens et al. 2014; Tempel et al. 2014a). Studies on the west side of the Sierra Nevada have found the availability and amount of late seral forest (canopy cover greater than 70 percent and dominance of medium and large trees) were positively correlated with territory occupancy, survival, and population growth (Seamans and Gutierrez 2007; Tempel et al. 2014a). Habitat edge is considered beneficial to spotted owls, perhaps increasing prey populations and access to prey by foraging owls. Recent changes in silviculture prescriptions have been developed that are designed to retain the stand structure and heterogeneity predicted based on historic vegetative patterns and also selected for by spotted owls (Knapp et al. 2012). Effects of these prescriptions on spotted owl populations have not been studied in detail.

Another threat to spotted owl persistence is habitat loss from high-severity fire. Spotted owls have been documented to use habitat that has burned at low to moderate burn severity that includes some proportion of high-severity fire (Roberts et al. 2011; Lee, Bond, and Siegel 2012; Lee et al. 2013; Lee and Bond 2015). The amount of suitable habitat (green forest), the amount of suitable habitat that burned at high severity, and salvage logging likely affect continued occupancy by spotted owls (Gutierrez, Manley, and Stine 2016). High-severity fires that results in the loss of dense mature forest, large snags and downed logs effectively remove preferred nesting and roosting habitat and can take centuries to regrow.

In the closely related northern spotted owl, while spotted owls did roost and forage within high-severity burn areas, the use was very low suggesting that this cover type was poor habitat for spotted owls (Clark, Anthony, and Andrews 2011). They found that annual survival rates were lower in northern spotted owls inhabiting burned areas or displaced by the wildfire as compared to owls that inhabited areas outside the burn perimeter (Clark, Anthony, and Andrews 2011). A radio telemetry study to examine California spotted owl use of habitat within multiple burn severities found that probability of use decreased with increasing severity, and also found that probability of use increased with low and high contrast patch edges compared to no edge (Eyes, Roberts, and Johnson 2017). This study suggests that a diversity of habitat types, including low and moderate severity fires, may be important foraging habitat for the species. While short-term benefits may be realized by spotted owls, such as increased prey and edge habitat, uncertainties remain regarding long-term occupancy and demographic performance of spotted owls at burned sites (Keane 2014). Specifically, uncertainty exists regarding how the amounts and patch sizes of high-severity fire will affect California spotted owl occupancy, demographics, and habitat over long time frames (Keane 2014). The results of simulation modeling research summarized in (Keane 2014) suggests that some fuels treatments can reduce fire risk and with minimal effects on owl reproduction, and may have long-term benefits of reducing wildfire risk that outweigh short-term effects of treatments.

There are limited opportunities to actively manage vegetation or fuels on the limited spotted owl habitats that occur on the Inyo National Forest due to the remote locations and generally limited access. If vegetation or fuels management projects are proposed, all alternatives include direction to limit treatment within protected activity centers with alternative C having the most restrictive direction. Although all alternatives provide for a protected activity center, they have slightly different direction, but all are intended to ensure that key habitat characteristics are retained and that disturbance is minimized near breeding sites. Direction for delineating home range core areas (alternative A) or territories (plan revision alternatives) also differs; however, both are intended to achieve similar outcomes of providing additional ecological conditions to support breeding in an area adjacent to the protected activity center. Both of these are currently moot given that there are no known nesting or persistent roosting sites on the Inyo National Forest and vegetation and fuels projects are expected to be limited in potential spotted owl habitats.

Barred owls are an increasing risk factor for California spotted owls in the Sierra Nevada. Barred owls can hybridize and also out-compete spotted owls. Barred owls were first recorded within the range of the California spotted owl in 1989 on the Tahoe National Forest. Two sparred owls (hybrids of spotted and barred owls) were reported in the Eldorado National Forest during 2003 to 2004 (Seamans, Corcoran, and Rex 2004). Barred owls were first recorded in the southern Sierra Nevada in 2004 (Steger, Werner, and Munton 2006). Ongoing research has documented 73 records of barred or sparred owls in the Sierra Nevada to date, with the majority of records from the northern Sierra Nevada (Tahoe, Plumas, and Lassen National Forests). Of note, five new records of barred owls were documented in the Stanislaus and Sierra National Forests in 2012, indicating further range expansion of barred owls in the southern Sierra Nevada. In 2017, confirmed barred owls were on the Sequoia National Forest. Barred owl numbers are likely higher than documented in the Sierra Nevada, as there have been no systematic surveys for them to date. Climate change may have negative effects on spotted owls. Increasing temperatures may affect spotted owl survival, reproduction, recruitment, and population growth (Gutierrez, Manley, and Stine 2016). Although there are no known or suspected barred owls on the Inyo National Forest, the plan revision alternatives provide direction for invasive species that would consider management actions in coordination with the State of California and other agencies, if needed. This would simplify coordination and developing and implementing or supporting plans of action compared to alternative A, which doesn’t have clarifying direction.

Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

When assessing the risks (i.e. loss of habitat from high intensity wildfires, past timber harvests, geographical expansion of barred owl) to this species, and climate change, alternatives B, B-modified, and D provide the largest amount of vegetation treatment and allow for the most flexibility on the use of tools, such as mechanical treatment, prescribed fire, or hand treatments. Alternative C proposes more use of prescribed fire over mechanical treatment. This approach would usually require some level of vegetation treatment prior to initiating prescribed burning. Weather conditions and other factors reduces the probability of treating areas as planned or as many acres. As a result, risks from large intensity fires are still a threat over a larger land area from alternative C.

Great Gray Owl

Great gray owl in other areas in the Sierra Nevada occupy meadows and early seral stage habitats adjacent to pine and fir forests between 3,500 feet and approximately 7,000 feet. Their presence on the Inyo National Forest is based on very few records and occurs at the extreme southeastern edge of their range. Because there are so few detections, it is difficult to know if they use different habitats on the Inyo National Forest compared to those typical of the west-side of the Sierra Nevada but their habitat is assumed to be within the Sierra Nevada montane zone in mixed conifer stands consisting of red fir, Jeffrey pine, and lodgepole pine, and adjacent or close to meadows.

Under alternative A, the Inyo would continue to manage this species as a Pacific Southwest Region sensitive species and follow agency direction to minimize impacts from site-specific projects and conduct a biological evaluation. Alternatives B, B-modified, C, and D adopt the 2012 Planning Rule requirement for the Forest Service to maintain or restore ecological sustainability, integrity, and diversity as the primary approach to provide for the persistence of species of conservation concern. All plan revision alternatives would identify riparian conservation area desired conditions and other plan direction that are designed to provide overall ecological integrity of meadow ecosystems, including habitat and ecological conditions to support all associated species.

A recent study found a weak negative correlation between grazed meadows on Stanislaus National Forest allotments and vole abundance (Kalinowski, Johnson, and Rich 2014b). Although these findings indicate the need for further evaluation, there are a number of potentially confounding variables that influence these results, including the fact that some grazed meadows were surveyed before grazing for the season began, making it difficult to compare before and after or even grazed and ungrazed meadows. Under all alternatives, if a great gray owl nesting territory is discovered, plan direction would guide evaluating the impacts of activities on the territory. Under alternative A, plan direction would establish a protected activity center and limit livestock grazing by establishing a residual stubble height to provide for prey species. The plan revision alternatives do not set a stubble height because meadow conditions can vary greatly on the national forest and they are different ecologically from those where nesting great gray owls are found on the west-side of the Sierra Nevada Range. Under the plan revision alternatives, if a nesting great gray owl territory is discovered on the Inyo, forestwide direction for at-risk species would provide for ensuring projects and land management activities are designed to maintain or enhance self-sustaining populations within the inherent capabilities of the plan area by considering the relationship of threats (including site-specific threats) and activities to species survival and reproduction. This would allow the best available scientific information to be used to determine if changes are needed to livestock grazing activities based upon actual conditions at nest sites.

Although management approaches for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives would adopt a framework for future management actions with regards to recreation management and resource protection.

Proposed plan components in the all alternatives are designed to move meadow and adjacent forest habitat conditions to a more desired ecological state than what currently exists. Alternative A would provide for the species by requiring analysis of effects to sensitive species during project planning and avoiding projects and activities that would lead to a trend towards federal listing. The plan revision alternatives have a number of ecosystem level and species specific plan components in place to mitigate risks to the species within its management authority, but cannot mitigate all threats for persistence. The Inyo National Forest is at the very edge of the species' range and it may not be within the inherent capability of the land to provide for a viable population of great gray owl in the plan area. Based upon this evaluation, for the plan revision alternatives, the final set of ecosystem plan components and the additional species-specific plan components, when carried out, would provide the necessary ecological conditions to maintain a viable population of great gray owl within its range. However, due to uncertainty about the species current viability, the limited amount of habitat on the Inyo National Forest, and potential future threats associated with climate change, it is not within the inherent capability of the land to maintain or restore the ecological conditions to maintain a viable population of great gray owl within the plan area.

Mt. Pinos Sooty Grouse

Mt. Pinos sooty grouse occurs in high elevation suitable habitat (6,000 to 10,000 feet within the Sierra Nevada montane and subalpine and alpine ecological zones) on the Inyo National Forest south of the city of Independence.

Alternative A does not provide specific forest plan direction for this species since it is not currently a sensitive species for the Inyo National Forest. The plan revision alternatives would manage this species as a species of conservation concern requiring management to manage for persistence over time. However, alternatives B, B-modified, and D provide a greater set of management tools such as mechanical and hand treatments, as well as prescribed fire and managing wildfires for resource benefits which can allow managers to strategically manage for Mt. Sooty grouse habitat so as to retain areas of dense forested stands, open pine and fir forest with large trees, and riparian areas. Alternatives B, B-modified, and D more effectively address climate change and ecosystem and watershed resilience than alternative C, and take more of a landscape and long-term management approach than does alternative C.

Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

In summary, Mount Pinos Sooty grouse is currently found in a geographically restricted area and may be a relict population of a once more widespread species that occurred in the Southern Sierra Nevada. Due to this limited distribution and a moderate population decline throughout its range, the Inyo National Forest may provide important refugia habitat. However, taxonomic uncertainty about the species may be a potential barrier for conservation action and hunting pressure could be an additive factor if the subspecies is misidentified in the field. In addition, sooty grouse habitat, particularly in the subalpine forest, may be especially at risk from climate change and interrelated effects of wildfire and drought, further increasing viability risk.

Species viability of Mt. Pinos sooty grouse is currently uncertain; however, proposed plan components are designed to move habitat conditions to a more desired ecological state than what currently exists. The Inyo has a number of ecosystem level and species-specific plan components in place to mitigate risks within its management authority, but cannot mitigate all threats for persistence. Based upon this evaluation, the final set of ecosystem plan components and the additional species-specific plan components, when carried out, would provide the necessary ecological conditions to maintain a viable population of Mount Pinos sooty grouse within its range. However, due to uncertainty about the species current viability, the limited amount of habitat on the Inyo National Forest, and potential future threats associated with climate change and taxonomic uncertainty, it is not within the inherent capability of the land to maintain or restore the ecological conditions to maintain a viable population of Mount Pinos sooty grouse within the plan area.

Willow Flycatcher

Willow flycatchers occupy riparian and wet meadow habitats. Alternative A would continue providing a level of protection to riparian conservation areas, including meadows. The current plan also includes standards and guidelines that guide livestock management through determining when livestock can graze in occupied meadows to protect breeding and limits the extent of utilization to protect willow habitats.

Alternatives B, B-modified, C, and D adopt the approach to species management of providing for ecological diversity and ecological integrity as the primary means to ensure the persistence of most species. Alternatives B through D provide forest plan direction to manage habitats and provide ecological conditions to provide for species of conservation concern, including the willow flycatcher. Alternative B allows for prescribed fire and mechanical as well as hand treatments to restore ecological integrity and improve resilience of riparian ecosystems to fire, drought, and climate change, but this would likely not affect the types of riparian habitats used by this species. Alternative B-modified proposes conservation watersheds, which includes areas on the Inyo National Forest occupied by willow flycatcher, such as the proposed Mono Lake Headwaters and the South Fork Kern River Headwaters conservation watersheds.

Alternatives B, B-modified, and D propose to change the way fire is managed by identifying strategic fire management zones that support greater opportunities for managing wildfire to meet resource objectives when it is safe to do so. This may improve the restoration of fire across larger landscapes and reduce the risk of fire burning outside of the natural range of variation in meadows and riparian areas that provide habitat. This would provide a greater benefit to this species by improving ecosystem and watershed resilience to climate change. Alternative D incorporates the same direction regarding at-risk species as alternatives B and B-modified. Alternative D focuses on the long recovery time for habitats of many at-risk species and is designed to lessen the rate of habitats adversely affected by large high-intensity fires by reducing fuels and restoring vegetation in upland areas and in some riparian areas that are outside the natural range of variability. Restoration would occur at an increased level. Alternative C does not strive for desired conditions with the natural range of variability for all habitat types.

Specific to willow flycatcher, alternative C emphasizes maintaining and restoring nesting habitat in Mono Lake Basin, whereas alternatives B, B-modified, and D do not.

Although management approaches for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

In summary, water use from expanding population pressure and human demands, coupled with increasing temperatures and temporal changes in precipitation and runoff events related to climate change, along with small declining populations that are subject to nest parasitism by brown-heeded cowbirds will continue to put this species and its associated habitat components at risk on the Inyo National Forest. Historically, annual flooding was a major disturbance needed to maintain the vegetation levels necessary for many wildlife species that use riparian habitat. Riparian habitat is currently departed from historic conditions due in large part to growing population demands for water that result in stream diversions and impoundments. The watershed is not wholly contained within the national forest and the Inyo has little control over water management outside national forest boundaries. For this reason, it will be difficult for the Inyo staff to fully restore this habitat to reference conditions. Species viability of willow flycatcher on the Inyo is currently uncertain; however, proposed plan components are designed to move habitat conditions to a more desired ecological state than what currently exists. The Inyo National Forest has a number of ecosystem level and species specific plan components in place to mitigate risks within its management authority, but cannot mitigate all threats for persistence.

Based upon this evaluation, the final set of ecosystem-level plan components and the additional species-specific plan components, when carried out, would provide the necessary ecological conditions to maintain a viable population of willow flycatcher within its range. However, key risk factors including climate change, ground water pumping and water diversions that occur off forest are not within forest service management authority and will continue to threaten meadow riparian and wet meadow habitat, making it difficult to maintain viability in the plan area.

Butterflies (Mono Lake Checkerspot, San Emigdio Blue, Apache Fritillary, Sierra Sulphur, Square Dotted Blue, Boisduval's Blue)

These 6 species of butterflies are found at higher elevation and are associated with similar habitat such as meadows, along dry river beds, riparian areas, or open habitat (forest openings). Two species (Boisduval's blue and square dotted blue) occur in different habitat types such as scree slopes, barren rides, and pumice fields (square dotted blue) whereas the Boisduval's blue occur in forest openings as well as sagebrush steppe, chaparral, and fields. All six species are relatively rare and limited where they occur. They are also susceptible to similar risks such as drying of microsite conditions, conifer encroachment, loss of habitat from human activities (such as herbicide and pesticide treatment on invasive species, and recreation development), and climate change.

Alternative A provides forest plan direction for aquatic and riparian ecosystems (riparian conservation areas) that most of these butterfly species depend on. Even though the Sierra sulphur butterfly is not a Pacific Southwest Region sensitive species, their habitat of high-elevation wet meadows receives protection (limiting management activities) from human-caused activities under alternative A. However, the square dotted blue and Boisduval's blue butterflies are currently not sensitive species, and not associated with riparian habitats. Even though habitat (scree slopes, barren ridges, and pumice fields) for the square dotted blue butterfly does not consist of riparian systems, some current protection may exist from limiting collecting of pumice through the administration of Forest Service permitting systems for protecting unique ecological habitat. This species is only known in one location on the Inyo National Forest. However, the Boisduval's blue has no species specific management plan under the current forest plan (alternative A) since its habitat does not consist of riparian systems, Alternative A would not be as beneficial for this butterfly species compared to the other alternatives.

Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

Alternatives B, B-modified, C, and D all provide improved protection to all six species of butterflies compared to alternative A (see "Features Common to Alternatives B, B-modified, C, and D" for species of conservation concern in chapter 2). These alternatives provide protection to these species through direction under required plan components for species of conservation concern. Where meadows are important for any of these species, flexibility for management to keep conifers from encroaching into meadows will be beneficial. Although alternative C limits mechanical treatments in conifer encroached riparian areas more than the other alternatives, the difference is small between alternatives B through D as it relates to these species.

A Cave Obligate Pseudoscorpion (*Tuberochernes aalbui*)

This species is known in only one location on the Inyo national Forest. Its habitat is within a cave that provides certain microsite conditions.

This species was not previously on the Pacific Southwest Region's sensitive species list and therefore was not specifically addressed in the current forest plan under alternative A. However, caves and similar special habitats are often protected and managed to minimize impacts from the public and forest activities and to protect the public. This specific cave has been protected with an installed locked gate to prevent entrance by the public. Alternatives B, B-modified, C, and D would manage this species as a species of conservation concern with forestwide forest plan direction. Since the cave is currently gated and no change in management is expected over the life of the forest plan, all alternatives should provide similar protection. Since this species is known from only one location, under alternatives B, B-modified, C, and D, plan direction would guide adjacent projects to minimize or mitigate adverse effects to the cave microclimate or environment to ensure the persistence of this species on the national forest. This consideration would not be required under alternative A but could still be considered during site-specific project planning since the pseudoscorpion is a native species.

Although management approach for sustainable recreation and designated areas vary between alternatives, all plan revision alternatives will adopt a framework for future management actions with regards to recreation management and resource protection.

Special habitats such as caves are limited and even though can be adversely impacted by certain activities, can also be managed effectively to protect associated resources through the installation of gates, and emphasized with mitigation measures for activities proposed nearby.

Cumulative Effects

The proposed management approaches under each of the alternatives are generally consistent with management of other lands within the cumulative effects analysis area. Although the alternatives vary in their ability and pace to achieve the desired conditions and some alternatives present more risk than others, it is not expected that the management approach under any alternative, combined with actions on other lands, would have an adverse cumulative effect on terrestrial wildlife habitat within the analysis area.

The majority of the land within the analysis area is managed by Federal agencies, primarily Forest Service, National Park Service (west side), and Bureau of Land Management (east side) and these agencies have individual resource management plans or shared, collaborative programs in place to guide the protection of natural resources, particularly in the face of changing climate conditions and large, high-intensity wildfires. The new focus of the 2012 Planning Rule on ecosystem integrity, resilience, and diversity is in close alignment with new direction for the National Park Service, which is to build ecosystem resilience for coping with changing climates. Park units are now obligated to consider climate change adaptation and manage for climate-resilient forests. The "Strategic Framework for Science in Support of Management in the South Sierra Nevada Ecoregion" was developed collaboratively by Federal land managers in the Southern Sierra Nevada ecoregion (including the Sierra and Sequoia National Forests and Giant Sequoia National Monument) to help mitigate impacts from, and adapt to, climate change

(Nydick and Sydoriak 2011b, a). The framework contains four goals: understanding where and why changes occur, anticipating possible futures, developing tools required to take effective action, and providing easy access to and delivery of information to target audiences. The framework will be carried out by the Southern Sierra Conservation Cooperative, a collaborative group of Government agencies and nonprofit organizations in the Southern Sierra Nevada Ecoregion. Sequoia and Kings Canyon National Parks, Sequoia National Forest, and Giant Sequoia National Monument are the first group of resource managers working together under the framework to carry out a pilot project to develop the capacity to manage fire under a “new lens” and to revise fire management objectives, tools, and methods. Therefore, given that the majority of the land in the analysis area is managed by Federal agencies and guided by individual resource management plans, as well as stronger, more relevant multi-agency partnerships, these strong consistencies in management direction are expected to provide for landscape-level resilience.

Large, high-intensity wildfires pose the most significant threat to wildlife habitat in the analysis area and many Federal agencies in this Southern Sierra Nevada ecoregion are working in partnership (and separately) to improve landscape resiliency to climate change and wildfires. The National Park Service uses managed wildfire and prescribed fire as resource tools where feasible and safe. The National Park Service has worked with the Sequoia National Forest in the past to manage wildfires for resource benefit, resulting in a high level of restoration (and lessened fire risk) in the area where the national forest meets the national park. The Inyo National Forest has an interagency fire program with the Bureau of Land Management in which staffs from both agencies participate in the planning of vegetation projects because of the proximity of lands, especially in the wildland-urban intermix.

Although each of the plan revision alternatives attempts to reduce the spread of large, high-intensity wildfires, improved resilience to such wildfires is anticipated to be higher under some alternatives compared to others. Under alternatives A and C, wildfires are anticipated to have an increasing trend in burned area, fire size, and fire intensity. Although alternative C places a heavy emphasis on the use of fire to achieve vegetation restoration, resilience to fire over much of the plan area would remain at the same low and very low resilience because of the more limited areas where fuels are reduced lowering the risks of managing wildfires or the complexity of conducting prescribed burns. The Endangered Species Act defines “cumulative effects” as the “effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation.” The National Environmental Policy Act gives “cumulative impacts” a broader meaning, which includes the impact of the action when added to other past, present, and future actions, regardless of the agency or person undertaking the action. Therefore, while alternatives A and C might provide less benefit to resilience than alternatives B, B-modified, and D, they do not constitute adverse conditions under either the Endangered Species Act or the National Environmental Policy Act simply from a lack of action.

Vegetation management activities are conducted on land managed by Bureau of Land Management, National Parks, and some State-managed lands. Both mechanical treatments and prescribed fire are used as management tools as they are on National Forest System lands. However, in national parks, the primary treatment methods include prescribed fire and managed wildfire; mechanical treatments are limited. Relatively fewer vegetation management projects are undertaken on county and privately owned land. The pace of restoration under alternatives B, B modified and D in treating both upland and aquatic systems may be more aggressive than those undertaken on other land ownerships in the analysis area but are expected to help more rapidly set the trajectory for a positive trend in ecosystem resilience (especially alternative D). Conversely, under alternatives A and C there is a greater risk of not being able to achieve desired conditions in a timely manner for ecosystem integrity, resiliency, and diversity of upland and aquatic systems because of the limit on tools that can be effectively used and constraints on habitat modifications related to canopy cover and large trees in upland systems and the use of mechanical equipment in aquatic systems.

Climate change resulting in higher temperatures, greater moisture evaporation, and prolonged drought will continue to affect ecosystems that support terrestrial wildlife species throughout the analysis area. Unlike alternatives B, B-modified, C and D that formally provide direction to manage the landscape and various ecosystems and watersheds for resilience to climate change, alternative A presents the greatest risk to the ability of habitat within the analysis area to sustain wildlife habitat as climate conditions change. Alternative A recognizes the need to address density of forests to reduce the risk of trees dying due to stresses related to prolonged droughts but this alternative is limited in the ability to treat terrestrial habitat at a rapid and large enough pace to substantially reduce the risk. Furthermore, the desired conditions for aquatic and riparian ecosystems in alternative A that support many terrestrial wildlife species and their prey do not specifically consider the change in temperature and precipitation related to climate change and other climate stressors to these systems. Management under this alternative could put more pressure on adjacent lands to support resilient habitat or influence habitat in adjacent lands where widespread climate-induced changes (such as massive tree mortalities, meadow desiccation, or large high-intensity wildfires) spread beyond the borders of the Inyo National Forest.

In contrast, alternatives B, B-modified, C, and D include desired conditions that emphasize improving watershed resilience to wildfire and climate change by treating vegetation and reducing fuels over larger areas, and mitigating and restoring impacts from unmaintained roads when they impair watershed function. These alternatives also include direction to manage for an increased risk of insects and diseases and changed fire patterns and cycles, and include desired conditions that recognize climate stressors on aquatic and riparian systems. These alternatives all consider and incorporate at least some recommendations from various climate vulnerability assessments and adaptation strategies and as a result have a better ability than alternative A (which supports fewer climate assessments and strategies) to build adaptive capacity into the climate change approach on National Forest System lands in the analysis area.

For various species strongly associated with certain plants for foraging or nesting habitat (such as butterflies and willow flycatcher) the spread of invasive plant species threatens this habitat. Management direction under any alternative is not expected to have an adverse cumulative effect on the existence or spread of invasive species in the analysis area, but alternatives B, B-modified, C and D have specific plan components that address the prevention, control, and possible eradication of terrestrial invasive species more formally than the current plans. However, alternative D has the greatest indirect risk of spreading invasive species because of the increase in acres treated, particularly acres mechanically treated. Nonetheless, the spread of invasive species is not anticipated to have an adverse cumulative effect in the analysis area because of mitigation required under each of the three alternatives. Both Bureau of Land Management and National Park Service also conduct invasive weed treatments. Invasive species exist on State, county and privately owned land and treatments there are varied.

Within the analysis area, grazing is permitted on lands managed by the Forest Service and Bureau of Land Management, and county and private lands. Grazing can be a management tool used for restoring habitats such as grassland important to various species (such as some invertebrates) but also has the potential to reduce habitat quantity and condition for other associated species. Some domestic sheep transmit life-threatening diseases to various native bighorn sheep. Allotments on National Forest System lands are managed following Forest Service utilization standards and this management direction does not vary by alternative. However, alternatives B, B-modified, C, and D more formally incorporate an implementation plan on the Inyo National Forest that focuses on reducing the risk of transmission of disease among domestic and native sheep. Domestic sheep and goats are found on private and county-managed lands adjacent to occupied Sierra bighorn sheep and therefore the risk of disease transmission in these areas is high regardless of management on National Forest System lands. In this way, under all alternatives, but especially B, B-modified, C and D, grazing on National Forest System lands is not expected to have an adverse cumulative effect on habitat or disease transmission elsewhere in the analysis area.

The entire analysis area receives a great deal of recreational use. Recreation can have varying degrees of adverse impacts on terrestrial wildlife such as habitat loss, degradation, and fragmentation; disruption of behavior (such as foraging or reproduction); reduction or change in supply and availability of food and cover; direct physical harm to individuals and offspring (eggs or young); and increased garbage, human food sources, noise, and pet presence. Roads and trails can be particularly problematic where they traverse otherwise undisturbed or minimally disturbed habitat, are unmaintained so they degrade habitat or inadequately contain users, or where a variety of user-created trails exist. Although recreation and access can adversely affect terrestrial wildlife and their habitat, the recreation approaches described under any of the alternatives are not likely to have an adverse cumulative impact on wildlife habitat in the analysis area. The approaches proposed under the various alternatives focus on addressing deferred maintenance (such as retrofitting existing sites to accommodate need, maintaining existing system trails) rather than creating new development or trails. Addressing deferred maintenance could improve wildlife habitat condition where sites or trails are degrading habitat (like passing through a meadow or wetland) and are upgraded or moved to higher capability lands. All alternatives continue to protect at-risk species from known threats associated with recreation. For example, all alternatives contain plan components to prevent nesting raptors from being disturbed from a variety of activities, including recreation activities.

Cumulative Effects under the Endangered Species Act. There are no foreseeable cumulative effects identified for federally listed or candidate species as well as critical habitat at this time. Those effects are not the same as how cumulative effects are defined under the National Environmental Policy At. Cumulative effects under the Endangered Species Act address non-Federal actions that are reasonably certain to occur because Federal actions will be subject to separate section 7 consultation when those projects are proposed. Cumulative effects are addressed fully in the biological assessment prepared for consultation with the U.S. Fish and Wildlife Service (USDA Forest Service 2017a).

For the Sierra Nevada bighorn sheep, cumulative effects from non-Federal actions include the continued management by the California Department of Fish and Wildlife. This includes activities such as continuing to conduct population surveys, evaluating and monitoring mortality in bighorn sheep, and evaluating and implementing translocation efforts as determined necessary to meet recovery plan distribution and population criteria. It is expected they will also continue to evaluate and oversee the management of mountain lions that are affecting species recovery. An additional non-Federal action is leasing of livestock grazing by Mono County in areas that could create a risk of contact with bighorn sheep. Mono County has recently allowed a sheep grazing lease of grazing on county lands to expire which substantially reduces the risk of disease contact. These non-federal activities would serve to improve ecological conditions for Sierra Nevada bighorn sheep.

Analytical Conclusions

Alternatives A and C have the most limited ability to mitigate the continuing increase in large, high-intensity wildfires and build adaptive capacity of ecosystems to climate change, although alternative C is better than alternative A at addressing climate change. Large wildfires with expansive areas of high-severity impacts are a major threat to many at-risk terrestrial wildlife species because they completely remove important habitat elements from a large portion of the landscape (like large living trees, dense canopy cover, down woody debris, riparian vegetation, and structural complexity) or they lead to type conversions with invasive species (like cheatgrass invading sagebrush and other arid vegetation types). Climate change is influencing all species and their habitats in far more complex ways but the primary management responses are mostly limited to improving vegetation resilience and providing for habitat diversity and habitat connectivity. Therefore, alternatives A and C present a greater risk to the quantity and condition of habitat to contribute to the recovery of threatened and endangered species, conservation of proposed and candidate species, and support the persistence of species of conservation concern.

Although alternatives B, B-modified, C, and D all focus on moving the vegetation types toward desired conditions, alternatives B, B-modified, and D are better positioned to achieve these desired conditions in a shorter timeframe because they focus on restoring resilience at a large landscape scale using a variety of tools that effectively decrease the expected amount of crown fire and large patches of high-severity fire effects toward the levels expected in the natural range of variation. The treatment pace and scale under alternatives B and B-modified are assumed to move the landscape to a moderate fire resilience within the first 10 years of plan adoption. The pace and scale of restoration proposed under alternative D is expected to surpass those alternatives in the ability to move the landscape to a more resilient position. These alternatives are also better than alternative A and slightly better than alternative C in building adaptive capacity of the ecosystems to climate change. There is greater uncertainty in the amount of restoration that would occur under alternative C because of the strong preference to use prescribed fire and to manage wildfires to meet resource objectives and limit the use of mechanical equipment whenever possible. This may result in fewer acres being restored due to higher costs or greater reliance on hand treatments with slow rates of treatment compared to alternatives B, B-modified and D.

Alternative B and B-modified represents a balance between alternatives A and C in that they propose to restore ecosystems toward their natural range of variation faster and more effectively than alternatives A and C because of the landscape level approach, more acres proposed for treatment, and a wider variety of restoration tools that can be applied. Alternative B provides a more cautious approach than alternative D by tempering the pace of restoration and implementing more fine-filter plan components. Ultimately, though, habitat for at-risk terrestrial wildlife species under alternative B continues to be at risk of loss due to large, high-intensity wildfires. Alternative D would more quickly achieve resilience of the landscape to large-scale disturbances (such as insect outbreaks, high-severity wildfire effects, and drought-related tree mortality), thereby providing a greater long term benefit to terrestrial wildlife habitat quantity and condition. However the management approach has greater potential for short-term impacts to achieve improved habitat condition.

Federally Listed Endangered, Threatened, and Candidate Wildlife Species Determinations

Key conclusions:

- The forest plan provides a programmatic framework for future site-specific projects and actions but does not prescribe specific projects or assign project locations. Plan components exist to ensure proposed actions avoid, mitigate or minimize impacts to Sierra Nevada bighorn sheep. All future project level activities that may affect this species will require project-specific assessments and consultation under section 7 of the Endangered Species Act.
- A combination of ecosystem level plan components and species-specific plan components for bighorn sheep provide for the ecological conditions that would contribute to the recovery of the species.
- The forest plan includes direction to avoid, mitigate or minimize the risk of disease spread from domestic sheep and recreational pack goats but cannot eliminate the risk entirely.
- The forest plan includes direction to evaluate areas where recreation uses may be adversely affecting Sierra Nevada bighorn sheep. Nonetheless, individual animals are likely to be affected by short-term disturbance and displacement by human activities.
- Critical habitat within wilderness areas will remain essentially undisturbed by management activity and may be benefited by restoring the ecological role of fire. There is an opportunity to improve portions of the winter range with prescribed burning and restoring fire which could improve forage quality and maintain open conditions to reduce predation risk. This could have short-term effects on habitat leading to long-term benefits.

For the purpose of consultation under the Endangered Species Act, we determined that despite plan components and plan content that would serve to avoid, mitigate, or minimize effects to federally listed species, some actions and activities may disturb and displace individuals and habitat could be affected by restoration activities. Since the forest plan is at a programmatic level, it cannot ensure that projects developed under it would have no effect or that all actions would be discountable, insignificant or beneficial to federally listed species. Therefore, we determined that adoption of the revised forest plan under all alternatives *may affect, and is likely to adversely affect* the Sierra Nevada bighorn sheep. We believe that because of the conservation measures of the alternatives, the U.S. Fish and Wildlife Service will determine that adopting any of the alternatives would not jeopardize the continued existence of the Sierra Nevada bighorn sheep when they issue a biological opinion.

For the purpose of consultation under the Endangered Species Act, we determined that although all alternatives are designed to conserve critical habitat, because some restoration actions, such as restoring fire using prescribed burning in winter range habitat may have short-term adverse effects to critical habitat, adoption of the revised forest plan under all alternatives *may affect and is likely to adversely affect designated critical habitats* for the Sierra Nevada bighorn sheep on the Inyo National Forest. Due to the conservation approach of the alternatives, we believe that the U.S. Fish and Wildlife Service will determine that at the programmatic level, all of the alternatives are not likely to result in destruction or adverse modification of critical habitat.

For the purpose of revising the forest plan, we determined that all plan revision alternatives have developed adequate plan components (ecosystem and species-specific) to provide for ecological conditions that contribute to the recovery of Sierra Nevada bighorn sheep within the plan area.

Wildlife Species of Conservation Concern Outcomes

In analyzing persistence of wildlife species of conservation concern, each species was evaluated individually (see appendix F in Volume 2). For most species, the determination is that: *It is beyond the authority of the Forest Service or not within the inherent capability of the plan area to maintain or restore the ecological conditions to maintain a viable population of these species in the plan area. Nonetheless, the plan components should maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range.* For example, due to circumstances that are neither within the authority of the Forest Service nor consistent within the inherent capability of the land, the plan area is unable to provide the ecological conditions necessary to maintain a viable population of the Nelson desert bighorn sheep. The reasons for this are that there is no authorized livestock grazing or permitting of uncontrolled domestic goats or sheep that are known to be in contact with the White Mountain bighorn sheep herd. However, the California Department of Fish and Wildlife has documented co-mingling of stray domestic goats with this bighorn population on private property (California Department of Fish and Wildlife 2015b). Because of this, the potential for population die-off is not caused by actions and cannot be addressed under Forest Service authority.

For the bi-state sage-grouse and cave obligate pseudoscorpion the determination is that: *The ecosystem plan components may not provide the ecological conditions necessary to maintain a viable population of these species of conservation concern in the plan area. Therefore, additional species-specific plan components have been provided. The combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain a viable population of these species in the plan area.*

All determinations provide both ecosystem and at-risk species-specific forest plan direction for persistence. The outcome for each species of conservation concern is displayed in appendix F. The emerging plan components under alternatives B, B-modified, C, and D when carried out, would provide the necessary ecological conditions to maintain viable populations of species of conservation concern. These alternatives include ecosystem coarse filter plan components aimed at protecting the broad habitats upon which these species depend and at-risk species-specific and ecosystem type-specific plan components.

Differences in the effects of alternatives suggests minor to major differences as to which would favor a particular species or group of species under the different alternatives. This determination depends upon the assumptions of treatments reducing the rate of habitat loss from large, high-intensity wildfires while providing for sufficient ecological conditions to meet the short-term needs of at-risk species. All determinations rely upon an adaptive approach to learning and making appropriate changes over time.

At-risk Aquatic Species

Background

This section summarizes current conditions of at-risk aquatic vertebrate and invertebrate species and the consequences of implementing the alternatives. At risk species include species listed as threatened or endangered (there are no aquatic candidate species on the Inyo National Forest), and aquatic species of conservation concern. The sections above on “Aquatic and Riparian Ecosystems” and “Terrestrial Vegetation Ecology” cover the general ecological integrity of the ecosystems upon which aquatic at-risk species depend, while this analysis focuses on effects to individual species.

This evaluation was completed by examining conditions of and threats to individual at-risk aquatic species, and also by examining the collective distribution patterns of at-risk aquatic species within the plan area, by watershed and by ecosystem. This approach assisted in understanding the broad relationship between a programmatic land management plan and the desired conditions identified for the at-risk species in the plan area. Desired conditions for at-risk aquatic species emphasize habitat that supports self-sustaining populations, precluding the need for listing, and improving conditions for these species.

Analysis and Methods

This analysis uses the same ecosystem plan component and species specific plan component approach as the "At-risk Terrestrial Wildlife" analysis to assess the alternatives' potential for providing the habitat characteristics to support wildlife diversity and the persistence of native species in the plan area. The coarse filter approach assumes that diversity is broadly dependent upon the integrity of the function, composition, and structure of the Inyo's terrestrial, riparian, and aquatic ecosystems to provide the ecological conditions that support the abundance, distribution, and long-term persistence of native species. This analysis compares the current abundance and condition of various habitats with ecological reference conditions (natural range of variability) based on the dynamic nature of ecosystems, recognizing they are not static (Landres, Morgan, and Swanson 1999a). It recognizes that disturbances or processes (fire, flooding, insects, and disease) and responses to those are part of the natural processes. However, integrity of whole ecosystems may not necessarily address all species' needs, so additional analyses were conducted to determine how well species specific plan components provided for the ecological conditions on the national forest to address key threats to species persistence.

The analysis area includes all National Forest System lands administered by the Inyo National Forest. In some cases, the best available scientific information for at-risk species' ecological relationships originated outside the analysis area. However, indicator measures and threat information from within the analysis area were used in making conclusions. Because of differences in available biological and threat information to federally recognized threatened, endangered, proposed, and candidate species versus species of conservation concern, and because the Forest Service Handbook outlines different procedures to identify plan components necessary to provide for the two groups of species, different approaches were used in their analyses.

Indicators and Measures

The indicators and measures for aquatic species are assessed the same as described for at-risk terrestrial species. For federally listed species, the adequacy of plan direction to protect, maintain, and restore habitat and the adequacy of plan direction to avoid, minimize, or mitigate potential adverse effects is evaluated for each alternative. An analysis for the preferred alternative (alternative B-modified) is documented in detail in the biological assessment submitted to the U.S. Fish and Wildlife Service and available in the project record. For aquatic species of conservation concern, we evaluate the extent and condition of habitat as indicators because they provide a reasonable estimate of ecological conditions needed to support the persistence of species of conservation concern and because relative differences among alternatives could be readily compared.

To evaluate extent and condition of habitat, we relied upon findings for environmental consequences from the "Aquatic and Riparian Ecosystems," "Terrestrial Vegetation Ecology," and "Fire Trends" sections. The extent and condition of each ecosystem or special habitat type served as the habitat indicator for individual species and for assemblages of at-risk species. However, the ecosystem types outlined in the "Aquatic and Riparian Ecosystems" section are roughly, but not exactly aligned with watershed characteristics to which at-risk aquatic species populations are often associated. Therefore, for some species, we also discuss the extent and condition of watershed characteristics if they better reflect the ecological conditions needed by a species.

Assumptions

- If a species is associated with a particular habitat, then the condition, amount, and distribution of those habitat elements available to the species on the landscape help to predict its distribution and abundance within that habitat.
- Habitat abundance and distribution similar to that which supported associated species during conditions as a consequence of evolutionary time, will likely contribute to their maintenance in the future (Haufler 1999). Therefore, habitat abundance, distribution, and condition similar to that within the natural range of variation for the habitats will likely contribute to species persistence in the future. (See also the "Aquatic and Riparian Ecosystems" section).
- The planning timeframe for the effects analysis is 10 to 15 years; other timeframes may be specifically analyzed depending on the resource and potential consequences.
- Monitoring identified in the plan monitoring program and any broader-scale monitoring will occur and the land management plan will be amended, as needed during the life of the plan.
- There will be a general increase in recreational demand as the human population size increases.
- Funding levels will be similar to the past 5 years.

Species Evaluated

Federally Listed Aquatic Species

The following table shows at-risk federally listed (threatened or endangered) aquatic species that are known to occur on the Inyo National Forest, providing common name, scientific name, and listing status There are no proposed or candidate aquatic species. The explanation of which listed species are considered to occur on the Inyo is included in the biological assessment.

Table 63. Federally designated aquatic species and critical habitat that occur in the Inyo National Forest plan area

Common Name	Scientific Name	Status	Critical Habitat
Mountain yellow-legged frog, northern Distinct Population Segment	*Rana muscosa*	Endangered	Final designated
Sierra Nevada yellow-legged frog	*Rana sierrae*	Endangered	Final designated
Yosemite toad	*Anaxyrus canorus*	Threatened	Final designated
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*	Threatened	Not identified
Paiute cutthroat trout	*Oncorhynchus clarkii seleniris*	Threatened	Not identified
Owens tui chub	*Gila bicolor snyderi*	Endangered	Final designated

Aquatic Species of Conservation Concern

For the coarse-filter approach, we grouped species by coarse-scale ecosystems described in the "Aquatic and Riparian Ecosystems" section. The environmental consequence findings of that section also compared existing and foreseeable future conditions of ecosystems to desired conditions, and this comparison was used as the basis of the coarse-filter evaluation. This coarse-filter approach assumes that persistence of species of conservation concern is broadly dependent upon the integrity of the ecosystems where they currently occur. However, because integrity of whole ecosystems does not necessarily ensure persistence of all species of conservation concern, particularly those with very limited distribution, we conducted additional fine-filter evaluations (species-specific and by special habitat) to ensure plan components provided ecological conditions that would maintain persistence for aquatic species of conservation concern.

The fine-filter evaluation was conducted by analyzing (1) special habitats that support suites of some species of conservation concern, and (2) known threats to each individual species of conservation concern. We grouped species by fine-scale habitats where possible, to enable a fine filter look at ecological conditions that affect populations. We also discussed documented threats that influence species trends in distribution and persistence.

Table 64 lists the seven aquatic species of conservation concern separated by taxa or type of animal. Note that terrestrial amphibian and invertebrate species are discussed in the "At-risk Terrestrial Wildlife" section.

Table 64. Aquatic species of conservation concern

Taxa (Type)	Common Name	Scientific Name
Amphibian	Black toad	*Anaxyrus exsul*
Amphibian	Inyo Mountains slender salamander	*Batrachoseps campi*
Amphibian	Kern Plateau salamander	*Batrachoseps robustus*
Fish	California Golden Trout	*Oncorhynchus mykiss aguabonita*
Aquatic invertebrate	Western pearlshell	*Margaritifera falcata*
Aquatic invertebrate	Wong's springsnail	*Pyrgulopsis wongi*
Aquatic invertebrate	Owens Valley springsnail	*Pyrgulopsis owensensis*

Affected Environment

Aquatic ecosystems include standing waterbodies such as lakes, ponds, tarns, springs and reservoirs, and flowing waterbodies such as rivers, creeks, and streams. Meadows and riparian areas are also important features of aquatic ecosystems.

Six fish species were native historically on the Forest, including some species unique to the Owens Valley, but most waters were barren of fish prior to transplanting activities which started in the late 19th Century (Moyle 2002).

The El Niño Southern Oscillation is partially responsible for approximately a decade-long inter-annual precipitation pattern in the southern Sierra Nevada. Drought years alternate with normal and extremely wet years during these decade-long oscillations. In recent years, the pattern has increased in variability. Within the same year, the Mediterranean climate may have long dry summer periods and highly seasonal winter precipitation.

The following sections describe the major types of aquatic habitat environments, as well as the topography, climate, and other factors that influence aquatic ecosystems and habitats. It is useful to evaluate the coarse filter approach by grouping species by aquatic habitat types they are most commonly associated with. All aquatic at-risk species occur in at least one of the aquatic habitat types and many occur in two or more and some species do not have a strict affinity to a particular habitat type but are identified to the most commonly associated type.

Rivers and Streams

The eastern side of the Sierra Nevada lies in the rain shadow of these mountains, which reach their highest elevations on the Inyo National Forest. This has created a dry, precipitation-dependent and precipitation-driven aquatic system. Streamflow is dependent on total precipitation and timing of snowmelt. Water flows can vary greatly from one year to the next, depending on precipitation levels. Some years, streams can be completely dry. Climate change is likely to magnify these shifts in two ways: (1) with decreasing precipitation resulting in more dry years, and (2) with earlier snowmelt and shifts in seasonal timing of flows (Hunsaker, Long, and Herbst 2014a). The rain-snow interface zone is predicted to occur at higher elevations, causing warming of streams earlier in the season. Rivers in valleys usually provide a consistent, abundant flow of water throughout the year, and support more complex faunal ecosystems.

Large rivers are predominately absent from the eastern Sierra Nevada mountains. Within the Inyo National Forest, there are valley bottoms including the upper Owens River, the South Fork of the Kern, a portion of the upper Kern River, and the San Joaquin River. There are many larger and smaller, sometimes seasonally flowing streams. Larger streams include Pine Creek, Bishop Creek, Big Pine Creek, and Rock Creek. An estimated 1,640 miles of perennial streams are on the Inyo National Forest.

Although most of the stream systems on the Inyo National Forest were fishless prior to stocking of nonnative trout, the South Fork Kern River and Golden Trout Creek and their tributaries, are within the range of the native California golden trout. This is unique because much of the west slope of the Sierra Nevada range above 5,000 feet was historically fishless due to glaciation during the Pleistocene and due to steep topography (Moyle 2002).

Other important native species found in river and stream systems include a variety of stream-dwelling macro-invertebrates (the aquatic life-cycle stage of many aquatic insects), such as caddis flies, mayflies, and stone flies which provide an important food source for native fish and other aquatic species.

Lakes and Ponds

Historically the lakes of the high Sierra Nevada were fishless and supported native fauna such as amphibians, aquatic insects, abundant zooplankton and phytoplankton. The mountain yellow-legged frog was an abundant resident of these lakes, with a life cycle that accommodated the seasons of ice in the high country (Knapp, Boiano, and Vredenburg 2007). Currently, many of the high-elevation lakes support introduced trout species of brook, brown, rainbow and golden trout, which has had an impact on frog populations (Knapp and Matthews 2000b and 2000c; Knapp, Boiano, and Vredenburg 2007). The historic introduction of trout into lakes throughout the Sierra Nevada mountain range has had the effect of eliminating the Sierra Nevada and mountain yellow-legged frog from over 90 percent of its historic range (Vredenburg et al. 2007). The introduction of trout into these lakes has also altered the life cycle and reduced the population numbers of macro-invertebrates and zooplankton within the lake (Knapp 2005; Schindler, Knapp, and Leavitt

2001). This reduction or elimination also affects the intensity of insect hatches that may affect bird migration patterns. The introduced and hatchery stocked trout are popular for recreational use, which is an important source of economic sustainability in the area. Climate change is expected to disrupt habitat for lake associated species. Both species of yellow-legged frogs are impacted by the fungal pathogen commonly referred to as chytrid fungus (Briggs et al. 2005; Rachowicz et al. 2006; Reeder, Pessier, and Vredenburg 2012) in addition to introduced trout, climate change and other stressors (Bradford et al. 2011, Davidson and Knapp 2007).

Ponds and other small waterbodies, such as tarns and pools, occur throughout the higher elevations within the Sierra Nevada Mountains. For the purpose of this discussion, waterbodies less than 2 acres were identified as ponds, of which there are 1,372 on the Inyo National Forest, with a total of 662 acres. Due to the shallow nature of these waterbodies, they are characteristically warmer during the summer months than lakes or streams. These features provide breeding habitat for the Yosemite toad and Pacific chorus frogs, which prefer meadow edges without deep water or adjacent steep terrain (Davidson and Fellers 2005). Most ponds occur in wilderness areas in the Sierra Nevada portion of the national forest. Little to no information is available on their condition or trend. Impacts have been observed, but not measured systematically, from recreation, grazing, or pack stock.

Lakes on the eastern side of the Sierra Nevada Mountains range in size from 1 acre to hundreds of acres. No lakes occur in the White Mountains, Inyo Mountains or Glass Mountains. Approximately 479 lakes larger than 2 acres occur on the Inyo National Forest, totaling about 46,000 acres.

Meadows, Seeps, and Springs

Meadows, seeps, and springs in the drier southern Sierra Nevada Mountains provide important habitat diversity and habitat for plants and animals.

Wet meadows are wetland habitats associated with groundwater seeps, stream and lake edges, and margins of seasonal drainages. This plant community is dominated by grass and grass-like species growing with varying combinations of herbaceous perennials and intermixed with the other habitat types noted in this section. Meadows play important roles in hydrology, erosion control, nutrient cycling, wildlife habitat, and recreation. Meadows are also important in maintaining hydrological processes downstream, conserving stream flows, channel erosion, and nutrient loads. Fens are continually wet areas where soils rich in organic material form.

Springs are small areas of water that come to the surface, and are fed by groundwater (Sada and Pohlmann 2002); the water temperature is relatively constant and in parts of the Inyo National Forest, often provide the only water over vast areas. Because of this, they are usually biodiversity hotspots, supporting many species that only occur there.

Little information is available on springs and seeps on the Inyo National Forest. Springs are scattered throughout the national forest, throughout different habitats. Existing information indicates that there are approximately 1,472 springs. Stressors on these systems include spring development, recreation use, concentrated livestock grazing use, diversions and unauthorized off-highway-vehicle use. Groundwater pumping can affect springs even miles away from the pumping source, causing springs to cease flowing. Many springs have been fenced from livestock use, and this is expected to improve function and condition of these springs. Even with predicted decrease in water throughout the area as a result of climate change, it is expected that springs will persist, but they may be the only water sources available for animals. Springs could receive additional impacts from species such as mule deer, burros, wild horses, and other animals as other stream sources dry, especially in the White and Inyo Mountains and Pizona area.

Meadows, seeps and fens are dependent on snowpack to sustain flow throughout the long dry period of summer. There is little information about the current trends for springs. As the rain-snow interface changes, lower elevation meadows and fens will be increasingly at-risk. Restoration of these systems holds great potential to provide multiple ecological and social benefits, despite their small share of the landscape. Evaluating the role of natural processes such as wildfire and management practices such as watershed restoration, on a larger, watershed scale, could aid the design of more effective strategies to promote long term resilience of these valuable systems.

The Inyo National Forest has over 25,000 acres of meadows larger than 1 acre. Meadows on the Inyo National Forest are experiencing increasing conifer densities and canopy cover over the past several decades that likely exceed the natural range of variability (Gross and Coppoletta 2013). Researchers sampled 10 randomly selected meadows on the Inyo National Forest as part of a Sierra Nevada study (Fryjoff-Hung and Viers. 2013). This study found vegetation cover and bare ground cover ranged from natural condition to moderately or heavily altered, depending on location. Encroachment (the ingrowth of trees) was the most common impact, with 60 percent moderately impacted and 10 percent slightly impacted.

Unpublished Inyo National Forest data indicate that all stream reaches through meadows in grazed and rested allotments fell within expected values for width and width-to-depth ratios, except for Monache Meadow, which showed that widths were wider and depths shallower than they should be for a functioning hydrologic system. In the past 20 years, much restoration work has been completed in meadows on the Inyo, especially the Kern Plateau. Observations by national forest staff suggest that, even in allotments that remain open to livestock grazing, restoration and changes in grazing management appear to have improved stream and meadow condition overall (USDA Forest Service 2013a).

Riparian Ecosystems

Riparian ecosystems are a critically important component of biodiversity, supporting a higher concentration of species diversity than most terrestrial ecosystems. They serve in part as a link between aquatic and terrestrial ecosystems, and play numerous important roles within the broader landscape (such as providing for wildlife habitat including habitat corridors, nutrient cycling, and proper watershed function). Because they are cool and moist in the hot summer, they are also attractive for many uses such as grazing, camping, fishing, and hydropower production. Despite their importance, Kattelmann and Embury (1996) estimated that riparian vegetation currently makes up less than 1 percent of the Sierra Nevada bio-region.

Riparian ecosystems are formed by the interacting effects of flooding, soil wetness, water table level, proximity to streams, height above water level, sediment, and ice scouring. Riparian areas consist of vegetation commonly associated with standing or flowing water, such as willows, alders, aspen, and meadows (Manley et al. 2000). Meadows are areas where grasses, sedges and rushes are dominant and flowering plants common. Willows, alders, cottonwoods and other woody vegetation dominate non-meadow riparian ecosystems, but flowering plants, sedges, and grasses are often present.

Riparian habitat is associated with the margins of seasonal and perennial drainages, and with seeps and wet meadow margins at scattered locations across the Inyo National Forest. Riparian habitat is dominated by willows including Lemmon’s willow (*Salix lemmonii*), Sierra willow (*S. eastwoodii*), Scouler’s willow (*S. scouleriana*), and mountain alder (*Alnus incana spp. tenuifolia*), with occasional quaking aspen (*Populus tremuloides*).

Riparian areas have an exceptionally high value for many wildlife species and are high in biodiversity due to the water, relative humidity, cooler temperatures and complex cover provided. Riparian areas provide water, thermal cover, migration and movement corridors and diverse nesting and feeding opportunities for many species (Grenfell 1988). They also serve as important corridors for species dispersal. However, many montane riparian communities are currently grown in with conifers and other vegetation due to fire exclusion.

Status and Threats for At-risk Aquatic Species

Federally Listed Aquatic Species

Mountain Yellow-legged Frog (Northern Distinct Population Segment) and Sierra Nevada Yellow-legged Frog

Status: Both species of yellow-legged frog were petitioned for listing under the Endangered Species Act in 2000 and the U.S. Fish and Wildlife Service determined that listing was warranted as threatened or endangered for this species in 2003; however, the listing was precluded at the time based on other higher priorities (USDI Fish and Wildlife Service 2003). Both species were listed as an endangered species in 2014 (USDI Fish and Wildlife Service 2014). Final critical habitat for each species was designated in 2016 (USDI Fish and Wildlife Service 2016a). For the mountain yellow-legged frog, there are seven designated critical habitat subunits covering approximately 221,498 acres within Fresno, Inyo and Tulare Counties, California. There are portions of three critical habitat subunits covering approximately 12,325 acres on the Inyo National Forest. For the Sierra Nevada yellow legged frog there are 24 designated critical habitat subunits covering approximately 1,082,147 acres within Lassen, Plumas, Sierra, Nevada, Placer, El Dorado, Amador, Calaveras, Alpine, Tuolumne, Mono, Mariposa, Madera, Fresno, and Inyo Counties, California. There are portions of six critical habitat subunits covering approximately 97,046 acres occur on the Inyo National Forest. No recovery plan has been completed for either species.

The mountain yellow-legged frog occurs primarily west of the Sierra Nevada crest on the Sequoia and Kings Canyon National Parks near the border with the Inyo National Forest. On the Inyo, the California Department of Fish and Wildlife conducts surveys for this species and has determined that populations currently exist in the Mulkey Meadows and Coyote Creek areas (California Department of Fish and Wildlife 2017a).

The Sierra Nevada yellow-legged frog occurs primarily west of the Sierra Nevada crest in Yosemite and Kings Canyon National Parks. On the Inyo, the California Department of Fish and Wildlife conducts surveys regularly for this species and has determined that populations occur in 10 management units identified by the State. These are located primarily in the Cathedral and Minarets critical habitat units in the Ansel Adams Wilderness west of Devil’s Postpile National Monument and June Lake and in the Mono Creek and Evolution/Le Conte critical habitat units in the John Muir Wilderness west of Bishop and Big Pine. A small portion of the Evolution/Le Conte critical habitat unit extends outside of wilderness in the Cow Creek and Baker Creek area.

However, these populations are believed to have been extirpated in 2010 (California Department of Fish and Wildlife 2017a).

The California Department of Fish and Wildlife, in conjunction with the Inyo National Forest, has been removing nonnative fish in some lakes to allow for reintroduction of yellow-legged frogs (California Department of Fish and Wildlife 2017a). Other restoration efforts, such as inoculating the frogs against *Bd* fungus, have been attempted and may help recover the species in the future. These efforts are coordinated by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Threats: The 2014 conservation assessment for mountain yellow legged frogs provides a detailed examination of risks to the mountain yellow-legged frog complex throughout its range (Brown et al. 2014). Across the species range, it identified 13 risk factors relevant to land and resource management. Three are considered focal risk factors that are linked to declines: Introduced fish and other predators, disease, and habitat loss and fragmentation. Ten additional risk factors are within the authority of the Forest Service to address but are not currently linked to declines: fire suppression activities, habitat restoration, livestock grazing, locally applied pesticides, mining, recreational activities (including pack stock), research activities, roads, vegetation and fuels management, and water development and diversion. Of these, the most relevant to consider on the Inyo National Forest are: fire suppression activities, habitat restoration, livestock grazing, and recreational activities (including pack stock). These are similar to the risks identified by the U.S. Fish and Wildlife Service (USDI Fish and Wildlife Service 2016a).

- **Introduced fish and predators:** Predation by introduced fish, especially nonnative salmonids (rainbow trout, golden trout, brook trout, and brown trout), is a recognized cause of decline of mountain yellow-legged frogs in the Sierra Nevada. In 2010, the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service adopted direct that prohibits fish stocking where it conflicts with conservation goals of federal recovery plans or within federally designated critical habitat for considered species, which include the currently listed Sierran amphibian species (ICF Jones & Stokes 2010). Thus, fish stocking no longer occurs within the areas occupied by these species. Although continued fish stocking has ended, many trout populations are self-sustaining and are likely to continue to persist unless purposely removed. Study of areas with fish removal has shown success at improving yellow-legged frog populations. Some fish removal in native species restoration projects has been implemented by the California Department of Fish and Wildlife within the Inyo National Forest and additional opportunities for fish removal and subsequent reintroduction of yellow-legged frogs exist on the Inyo (California Department of Fish and Wildlife 2017a).
- **Disease:** The risk of disease, particularly chytridiomycosis, is a serious contributor to mountain yellow-legged frog declines. Major population crashes have resulted from chytridiomycosis infections, and the amphibian chytrid fungus, *Bd*, has been confirmed as a widespread threat to mountain yellow-legged frog persistence in the Sierra Nevada (Brown et al. 2014). Other pathogens may be contributors to declines, but their status is unknown. Of the 27 populations on Inyo National Forest, 10 of the 27 are *Bd* negative (California Department of Fish and Wildlife 2016). Populations that are *Bd* positive result in die offs or are persisting in the presence of *Bd* which is being investigated by researchers. The Conservation Assessment recognized that little can be done to manage for this risk factor unless vectors of these pathogens over which management can influence are identified and

unfortunately, the interactive effects between pathogens and other stressors remain largely unstudied (Brown et al. 2014).

- **Habitat loss and fragmentation:** Direct habitat loss is not a relevant factor for the Inyo National Forest given the extent of habitat and because the majority of populations and critical habitat are located in designated wilderness or in other remote areas.
- **Fire suppression activities:** In the parts of the species' range that occurs in wilderness areas, intensive fire suppression activities are rarely conducted and mechanized equipment generally is not used. In these remote areas, minimum-impact fire suppression techniques are used and may represent the best alternative to protecting mountain yellow-legged frogs and their habitat.

  Concerns regarding the effects of aerial application of fire retardant on aquatic systems and federally listed species were addressed in the Forest Service decision that directs aerial retardant tanker pilots to avoid application of retardant or foam within 300 feet of waterways (USDA Forest Service 2011c). A "waterway" is considered to be any body of water including lakes, rivers, streams and ponds irrespective of whether they contain aquatic life. Although the initial analysis was completed prior to these species becoming federally listed, the analysis is being updated; areas to avoid for the mountain yellow-legged frog, Sierra Nevada yellow-legged frog, and Yosemite toad are currently included in aerial retardant avoidance maps.
- **Livestock grazing:** There is currently no livestock grazing within currently occupied habitats for Sierra Nevada yellow-legged frog, though active cattle allotments do contain designated but unoccupied critical habitat. One active cattle allotment, the Mulkey Allotment, does contain occupied mountain yellow-legged frog habitat. No other occupied mountain yellow-legged frog habitat is within any active allotment. As with the Sierra Nevada yellow-legged frog, there are other allotments that do contain currently unoccupied designated critical habitat. Within the Mulkey Allotment, as well as currently unoccupied allotments, riparian conservation area trampling standards minimize localized threats to habitat from livestock grazing.
- **Recreational activities, including pack stock:** The risk level of recreational impacts to the mountain yellow-legged frog is unknown, but the nature of many recreational activities places humans in direct contact with mountain yellow-legged frogs or their habitat. Most recreational activities are localized, but in some cases, such as trails and campsites, activities are persistent and long term. In high-use areas, recreational activities are likely to add cumulatively to stressors on small populations, especially those already stressed with nonnative fish. Dispersed recreational activities such as hiking and camping, may pose a more moderate risk to the species because they may have localized impacts. Numerous areas in wilderness have restrictions on the number of visitors with or without pack stock and commercial pack stock is managed with quotas. These management restrictions are designed to limit the impact on resources while providing for the highest quality wilderness experience. No specific data exists for this risk factor relative to the mountain yellow-legged frog but the U.S. Fish and Wildlife Service stated that "[p]ackstock use is likely a threat of low significance to mountain yellow-legged frogs at the current time, except on a limited, site-specific basis" (USDI Fish and Wildlife Service 2014). Habitat changes due to pack stock grazing may pose a risk to some remnant populations of frogs and, in certain circumstances, may slow recovery of populations in heavily used areas, although no specific sites where this situation occurs are known.

- **Other risk factors:** Locally applied pesticides, mining, research activities, and water development and diversion are other risk factors evaluated in the Conservation Assessment (Brown et al. 2014) that are not expected to be a substantial risk to yellow-legged frogs on Inyo National Forest. Since most occurrences are within wilderness, pesticide application, mining, and water development and diversion would rarely, or never, occur. Current Forest Plan direction (2004 Sierra Nevada Forest Plan Amendment) requires that any pesticide application within 500 feet of known occupied sites would avoid adverse effects to individuals or their habitats and future projects would require compliance with section 7 of the Endangered Species Act and consultation with the U.S. Fish and Wildlife Service as needed. Research activities affecting federally listed species require permits from the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service, who will insure the species' protection.

  Four risk factors identified in the conservation assessment fall largely outside the authority of the Forest Service but have the potential to impact populations on a regional or global scale. These include acid deposition, airborne contaminants (including pesticides), climate change, and UV-B radiation. The Forest Service has few options to reduce the risk these factors pose to the two species of yellow-legged frogs and their habitat. The U.S. Fish and Wildlife Service determined that acid deposition, airborne contaminants, and UV-B radiation are not known to pose a threat (current or historical) to either species of yellow-legged frog (USDI Fish and Wildlife Service 2014). Climate change poses a substantial future threat to the persistence of both yellow-legged frog species given their highly aquatic nature. The effects can be expressed in a variety of ways such as changes in hydrological systems that reduce habitat quantity and quality or that contribute to other stressors that impact individuals and ultimately population persistence. Improving ecosystem integrity in the aquatic and riparian systems that provide yellow-legged frog habitats may ameliorate local risk factors by improving the resiliency of populations.

Yosemite Toad

Status: The Yosemite toad was listed as a threatened species in 2014 (United States Department of the Interior 2014). Final critical habitat was designated in 2016 to include approximately 1,812,164 acres in Alpine, Amador, Calaveras, El Dorado, Fresno, Inyo, Lassen, Madera, Mariposa, Mono, Nevada, Placer, Plumas, Sierra, Tulare, and Tuolumne Counties, California. (United States Department of the Interior 2016a). Of the 16 critical habitat units, five are located on the Inyo National Forest, covering approximately 83,939 acres. Critical habitat Unit 15, Upper Goddard Canyon, has approximately 4 acres of overlap on the Inyo NF which are essentially small slivers along the national forest boundary with Kings Canyon National Park and are all in the John Muir Wilderness. A Recovery Plan for Yosemite toad has not been completed.

Yosemite toad occurs primarily along the Sierra Nevada crest and west of the crest. On the Inyo National Forest, populations occur in the Tuolumne Meadows/Cathedral critical habitat unit west of Mono Lake and in scattered populations in the Silver Divide and Humphreys Basin/Seven Gables critical habitat units from Devils Postpile National Monument south and east to the Gable Lakes area, which is west of Bishop. A small portion of critical habitat exists outside of designated wilderness in the Lake Mary area.

Threats: The conservation assessment for Yosemite toad was completed after the species listing and provides a detailed examination of risks to the Yosemite toad throughout its range (Brown et al. 2015). It identified several risk factors that currently are not likely to be major causes of rangewide declines but may be important in specific situations, particularly where toad populations are small. Seven of these factors are relevant to the Yosemite toad population on the Inyo National Forest, and could be affected by the Inyo's management activities. These include (1) fire management, including fire suppression; (2) introduced fish and other predators; (3) livestock grazing; (4) locally applied pesticides; (5) recreational activities including pack stock; (6) roads; and (7) vegetation and fuels management. It further identified that legacy effects from some of these risk factors (such as livestock grazing) may have contributed to Yosemite toad declines, particularly those that resulted in meadow drying, shortened hydroperiods of breeding habitats, and potentially, lowered breeding success. Some improved management may have lessened the impacts of some of these risk factors but other legacy impacts may remain.

Other risk factors fall largely outside the authority of the Forest Service but have the potential to impact populations on a regional or global scale. These include acid deposition, airborne contaminants, including pesticides, climate change, disease, and UV-B radiation. The Forest Service has few options to reduce the risk these factors pose to Yosemite toads and their habitat. Climate change likely poses the most risk to the species given the Yosemite toad's reliance on very shallow ephemeral water for reproduction. Reduced snowpacks may result in less available surface water, fewer breeding pools, and faster drying of breeding sites, all of which may lead to less successful reproduction. Early snowmelt and warmer temperatures may affect the Yosemite toad's behavior, the timing of reproduction and other phenological events, the duration of tadpole development, and resulting effects on survivorship. Improving ecosystem integrity in the meadows and uplands that provide Yosemite toad habitats may ameliorate local risk factors by improving the resiliency of Yosemite toad populations.

- **Fire management:** Fire management, including suppression, has occurred since the early 1900s and has resulted in changes to the fire regime with a longer fire return interval and subsequent increase in vegetation and fuels in some areas. This has led to an increase on many fires of higher fire severity effects when fires do occur and larger extent of fires where fuels have become more continuous. This effect has occurred slightly less in the higher elevations and remote areas where Yosemite toads occur due to naturally longer fire return intervals and sparser vegetation due to harsher conditions and shorter growing season. In addition there is an emphasis to use minimum impact fire suppression techniques within wilderness areas when fires do occur which has allowed some fires to burn more areas like they would have naturally.
- **Introduced fish and other predators:** Introduced fish and other predators is a legacy threat that lingers where introduced fish populations remain persistent. The California Department of Fish and Wildlife, working with the U.S. Fish and Wildlife Service, has reduced stocking to areas where native trout or other native aquatic species occurred (ICF Jones & Stokes 2010). While high mountain lake stocking ceased in 90 percent of previously stocked lakes by 2010 (Lentz and Clifford 2014); some high elevation waters still contain remnant populations from previously stocked fish. The conservation assessment discusses the risks of introduced fish on Yosemite toad and determined that the risk appears low and addressing the direct effects of introduced fish is not a high priority for conservation options (Brown et al. 2015). However, it recognizes that indirect effects to changes in food webs, nutrient cycling, and pathogen transmission are unknown and worthy of future studies.

- **Livestock grazing:** Livestock grazing has not occurred within Yosemite toad habitat in recent years, as there are no active allotments within critical habitat. Therefore, livestock grazing does not affect the Yosemite toad on the Inyo National Forest.
- **Locally applied pesticides:** While pesticides are rarely or never used within designated critical habitat for Yosemite toads, due to remoteness and lack of need, they could be used if an invasive weed species was thought to have potential for ecosystem impacts. Current forest plan direction (2004 Sierra Nevada Forest Plan Amendment) requires that any pesticide application within 500 feet of known occupied sites would avoid adverse effects to individuals or their habitats, and therefore pesticide use is not a threat within the plan area.
- **Recreation activities, including pack stock:** Recreational activities, including pack stock grazing is widespread across the range of the Yosemite toad, and generally has high overlap with the species and its habitats because of the human attraction to meadows, ponds and other water bodies. The specific impacts of this risk factor to the species on Inyo National Forest are unknown. Recreation activities may locally affect meadow hydrology (as with pack stock grazing or a trail intercepting water flow) or potentially to the toads themselves, including in nonbreeding habitats. In general, the level of risk is low at the broader range scale because of the dispersed nature of many recreational activities. On the Inyo, numerous areas within wilderness have restrictions on the number of visitors with or without pack stock. Commercial pack stocks have limited quotas as well. These restrictions are designed to limit the impact on resources while providing for the highest quality wilderness experience. Commercial pack stock grazing is not allowed in occupied habitat until after the breeding cycle. The chronology is based on annual precipitation, for example in 2013 the “on-date” was July 23 and in 2017, following a record wet year, the “on-date” was determined to be August 10 for elevations between 6,000 feet to 8,000 feet and September 12 for elevations above 8,000 feet.
- **Roads:** The construction, reconstruction, and maintenance of roads as well as the use of roads can affect Yosemite toads by direct mortality of individuals moving overland or by impacts to habitat from changes in water flow or increased sediment. In the area of critical habitat outside Wilderness, several roads and campgrounds currently exist around Lake Mary, but are not known to be affecting the existing Yosemite toad population. The Yosemite toad sites near Crystal Lake and TJ Lake are within an inventoried roadless area and roads do not exist and road construction is unlikely.
- **Vegetation and Fuels Management:** Vegetation management could occur in the non-wilderness portions of the critical habitat near Lake Mary. Vegetation management would primarily be focused on improving the resilience of forest vegetation to contribute to the scenic character of this heavily used recreation area and providing for public safety by managing dead and dying trees. Fuels management, primarily management of surface and ladder fuels where they may increase the risk of adverse wildfire behavior and threaten recreation sites, could occur within around roads and campgrounds and facilities. This could involve large heavy equipment, but is more commonly accomplished by smaller equipment and work by hand and often involves piling and burning smaller fuels and prescribed burning.

Lahontan Cutthroat Trout

Status: Lahontan cutthroat trout was listed as endangered in 1970 (USDI Fish and Wildlife Service 1970), but was subsequently reclassified as threatened in 1975 to facilitate management and allow regulated angling (USDI Fish and Wildlife Service 1975). Critical habitat has not been designated for this species. There is one “out-of-basin” population on the Inyo National Forest. Out-of-basin populations are those located outside of the historical range of the species. The species is managed according to the recovery plan published in 1995 (USDI Fish and Wildlife Service 1995b).

The Lahontan Cutthroat Trout Recovery Plan identified a criteria for delisting by population segment when management has been instituted to enhance and protect habitat required to sustain appropriate numbers of viable self-sustaining populations (USDI Fish and Wildlife Service 1995b).

The Lahontan cutthroat trout was established in O’Harrel Creek as an out-of-basin population and is the only occurrence of the species on Inyo National Forest. The fish occupy approximately one-half mile of the 2-mile discontinuous stream that is located north of Benton Crossing in the Glass Mountains. The population is periodically surveyed by the California Department of Fish and Wildlife with population declines noted in recent years, which is suspected to be due to increased sediment from the 2007 “O’Harrel” fire.

In 2001, the 1,870 acre O’Harrel critical aquatic refuge was established to be managed for the recovery of this species (USDA Forest Service 2001b).

Threats: The severe decline in occupied range and numbers of Lahontan cutthroat trout in its endemic range is attributed to a number of factors including hybridization and competition with introduced trout species; alteration of stream channels and morphology; loss of spawning habitat due to pollution and sediment inputs from logging, mining, livestock grazing practices; urbanization; migration blockage due to dams; reduction of lake levels and concentrated chemical components in lakes; loss of habitat due to channelization; de-watering due to irrigation and urban demands; and overfishing (United States Department of the Interior 1995a). However, within the out-of-basin population along O’Harrel Creek, the following are relevant threats to consider.

- **Loss of Habitat:** For the out-of-basin O’Harrel population, the primary threat to the population is due to the habitat being essentially unsuitable for trout habitation. Streams on alluvial fans are subject to flashy flows and instability due to the alluvial nature of the substrate. Although much work has been completed within this channel to stabilize portions to create suitable habitat, portions of the stream are subject to low flows, high temperatures and constant re-location of the channel across the fan. Historic grazing in the area most likely created conditions that channelized the stream through the fan; however, now the channel is established and all occupied habitat is fenced and excluded from grazing. High volumes of sediment input, which define the geomorphology of alluvial fan development, are also a constant threat to the resident trout, as noted in the decline of population numbers resulting after the “O’Harrel” fire increased fine sediment input into the stream.
- **Other Threats:** Other threats include impacts from dispersed recreation activities and camping within the section of private land located at the middle of the available habitat. Since this activity occurs on private lands, it is outside the authority of the Inyo National Forest to manage.

Paiute Cutthroat Trout

Status: The Paiute cutthroat trout was originally listed as endangered in 1967 (USDI Fish and Wildlife Service 1967) but was subsequently reclassified as threatened in 1975 to facilitate management and allow regulated angling (USDI Fish and Wildlife Service 1975). Critical habitat for this species has not been designated. A Recovery Plan for the Paiute cutthroat trout was developed in 1985, and revised in 2004 (USDI Fish and Wildlife Service 2004). The most recent 5-Year Review was completed in 2013 (USDI Fish and Wildlife Service 2013).

The Paiute cutthroat trout occurs in two out-of-basin populations on Inyo National Forest in the North Fork of Cottonwood Creek and Cabin Creek, both in the White Mountains Wilderness. The North Fork of Cottonwood Creek population is limited to a 3.4 mile stretch of the uppermost portions of the creek that is isolated from other trout species by a natural barrier. The Cabin Creek population appears to have recently expanded downstream to Leidy Creek and appears isolated from other trout species by a diversion.

In 2001, the 28,770 acre Cottonwood Creek critical aquatic refuge was established around the genetically pure population of Paiute cutthroat trout. This population has been used in 2017 to augment existing populations in the native Silver King Creek on the Humboldt-Toiyabe National Forest.

Threats: The recovery plan (USDI Fish and Wildlife Service 2004) and subsequent 5-Year Review (USDI Fish and Wildlife Service 2013) was reviewed and two threats in the five-factor analysis were determined to be of higher concern to Paiute cutthroat trout and its habitat relevant to the plan area: Destruction or modification of habitat, and other natural or man-made factors.

- **Destruction or modification of habitat:** Nonnative fish pose a threat, primarily from hybridization that can result in loss of available habitat or range restrictions. Nonnative rainbow trout are present downstream of these two populations but are currently isolated by barriers: a natural barrier for the North Fork of Cottonwood Creek and an artificial barrier for Cabin Creek.

  There are threats of population isolation and habitat fragmentation due to limited stream extents for these two locations, Neither of these populations meet long-term persistence criteria for the minimum amount of stream habitat thought to be necessary to sustain at least 2,500 individuals. The North Fork of Cottonwood Creek has approximately 3.4 miles of occupied habitat and Cabin Creek has approximately 1.5 miles of occupied habitat which are less than the 5.8 miles of stream habitat estimated to provide for persistence.

  Historically, livestock grazing (both cattle and sheep) occurred over much of the high Sierra Nevada mountain range, wherever forage was available. Grazing of livestock is noted as having potential to degrade habitat for Paiute cutthroat trout. Considerable effort in the 1990s was put into reducing sediment input into the North Fork of Cottonwood Creek, along with the suspension of grazing in the Cottonwood Creek and Tres Plumas Allotments in 2000. The grazing allotments are in non-use status but are not closed. If stream and riparian conditions can be maintained or continue to improve, future use of the allotments could be considered but this would require a site-specific analysis that would require consultation with the U.S. Fish and Wildlife Service if it would affect this species. The removal of livestock has resulted in stabilized streambanks and the re-establishment of willows; however, spawning substrate is still a limiting factor in this high elevation, dolomitic-dominate landscape. Cabin Creek is located within the Cabin Creek Allotment and grazing was authorized in the allotment in 2010 as a continuation of the grazing permit and is covered under Biological Opinion File No. 84320-2010-F-0088, dated June 1, 2010, by the Reno Field Office of the US Fish and Wildlife Service. However, the Cabin Creek area has not been grazed since 2005 due to restrictions in timing that are not compatible with the current grazing operation.

- **Other Natural or Manmade Factors:** Increases in water temperature as a result of increased summer air temperature and changes in precipitation affecting streamflow could increase stress levels which may increase the susceptibility to disease. Since a fungal disease already exists within the North Fork of Cottonwood Creek population, if stress levels increase, it could result in higher levels of post-spawning mortality which could affect the persistence of the population.

  There is a risk of adverse effects if wildfires burn outside of the characteristic fire regime and affect occupied habitat because there are no opportunities for recolonization if the entire occupied segment is affected. Cottonwood Creek is a narrow boulder canyon with signs of single tree lightning strikes. North facing trees are widely spaced on the steep rocky slope. The opposite side is riparian vegetation then sage brush that is not likely to carry fire. Willows were planted following changes in grazing management and are well established in the creek and have enough dead woody debris to provide fuel. In 2017 the willow recruitment was in groups and not continuous, reducing the risk for fire to carry throughout the entire riparian of the North Fork of Cottonwood Creek.

Owens Tui Chub

Status: The Owens tui chub was listed as endangered and critical habitat was designated in 1985 (USDI Fish and Wildlife Service 1985). Designated critical habitat in proximity to the Inyo National Forest includes portions of the Owens River Gorge and the springs and outflow channels at the Hot Creek Hatchery, which fall within private owned land within the Inyo administrative boundary but is mapped only on private lands and no critical habitat occurs on the Inyo. A small portion of the settling ponds of the Hot Creek Hatchery does extend on to the Forest but is not mapped as being critical habitat and genetic analysis has shown that the Owens tui chubs in this population are no longer pure and this population is not being managed for species recovery (California State Energy Commission 2012). Therefore, no designated critical habitat for the Owens tui chub occurs on lands managed by the Inyo National Forest and no critical habitat would be affected by any alternative.

When federally listed, the Owens tui chub was known from only two locations. Since listing, additional populations were established and there are now six recognized locations. Of those, three are located on the Inyo National Forest: Little Hot Creek Pond, Sotcher Lake, and a portion of the settling ponds at the Hot Creek Hatchery.

The Little Hot Creek Pond population is located in an artificial pond constructed in 1986 to enhance waterfowl habitat. In 2001, the Little Hot Creek critical aquatic refuge was established to protect these species. The area surrounding the pond is currently fenced to exclude livestock grazing and recreation use. The private land parcel upstream of the Little Hot Creek Pond is known as the Hot Creek Pit and is a former clay (kaolin) mine. It is unknown if any future activities are planned at this site. There are additional private land parcels downstream towards the Owens River. Agricultural and other land uses on the downstream parcels are expected to continue. The Little Hot Creek Pond is close to the national forest boundary and water withdrawals downstream and outside of the national forest are responsible for maintaining the barrier on Little Hot Creek which is required to avoid the risk of hybridization from contact with Lahontan tui chub.

The out-of-basin population in Sotcher Lake is believed to have originated from an accidental release associated with trout stocking from the Hot Creek Hatchery in the early 1950s (Chen, Parmenter, and May 2007). Sotcher Lake is in the heavily used recreation area around Reds Meadow near Devil's Postpile National Monument. Little is known about this population.

The small portion of the settling ponds of the Hot Creek Hatchery extends onto the Inyo National Forest. However, the population of Owens tui chub in the settling pond have recently been studied by the California Department of Fish and Wildlife and it has been determined that they are not genetically pure because they have introgressed with Lahontan tui chubs. Since this population no longer contributes to the recovery of the species, it is not analyzed further in this document.

Threats: The Recovery Plan (United States Department of the Interior 1998) identified three categories of threats to be of higher concern to Owens tui chub and its habitat including: destruction, modification, or curtailment of habitat or range; disease or predation; and other natural and manmade factors.

- **Destruction or modification of habitat:** When originally listed, extensive habitat destruction and modification was the primary threat to the Owens tui chub (USDI Fish and Wildlife Service 1985). Currently, most streams and rivers in the Owens Basin have been diverted and some impounded. The Owens tui chub, which used to occur throughout the Owens River and its tributaries in the Owens Basin, is restricted to six isolated populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in man-made ponds at upland sites with water supplied by artificial methods. The occupied habitat at Hot Creek Headwaters, Little Hot Creek Pond, White Mountain Research Station, and Mule Spring is 2 acres or smaller at each site. The habitats for these five populations are threatened by water diversions, failure of infrastructures that deliver water to these habitats, and/or emergent vegetation.

  Most of the water rights in the Owens Basin are owned by the city of Los Angeles. Currently, the demand for water from the Owens Basin is high and growing as Los Angeles continues to grow. The Los Angeles Department of Water and Power operates and maintains dams, diversion structures, groundwater pumps, and canals to capture and convey much of the water from the Owens Basin to Los Angeles. Ground water, which provides water to isolated springs and springs that are the headwaters of streams in the Owens Basin, and surface water are also used extensively for agriculture and municipal purposes within the Owens Basin. These man-made changes to aquatic habitat in the Owens Basin dramatically reduced suitable aquatic habitat for the Owens tui chub. They reduced the occurrence of the Owens tui chub from a common, wide-ranging species in the Owens Basin to a rare species occurring at a few sites, representing less than 1 percent of the fish's historical range (USDI Fish and Wildlife Service 1985).

  In addition to the increasing water demands for the greater Los Angeles area, areas adjacent to the Owens Valley (such as Round, Chalfant, and Hammil Valleys) are growing, and the demand for water is growing. This increased demand has resulted in an increased withdrawal of ground and surface water from the Owens Valley Groundwater Basin, which affects springs and other surface waters in the Owens Basin (Pinter and Keller 1991).

Habitat requirements for the Owens tui chub include aquatic submerged vegetation but not large amounts of emergent vegetation. At the Little Hot Creek Pond, invasive emergent plants (such as cattail) have altered the aquatic habitat. Cattail proliferation results in deposition of large amounts of organic biomass, eventually converting aquatic habitat to upland habitat (Potter 2004) which can result in a loss of habitat. In addition, dense emergent vegetation provides cover for nonnative predators, such as bullfrogs and crayfish. The area around Little Hot Creek pond was evaluated along with the California Department of Fish and Wildlife for management options for the emergent vegetation but the specific equipment needed wasn't available and no project has been initiated to date.

- **Disease or predation:** Predation by introduced nonnative fish, specifically brown trout, has been a major threat to the Owens tui chub. Predation by nonnative largemouth bass and brown trout, both abundant in the Owens River system, has been identified as a factor eliminating Owens tui chubs from much of their historical range in the Owens River (Chen and May 2003). Much of the recreation-based economy of the Owens Basin depends on recreational fishing, primarily for trout and largemouth bass. Because of the miles of riverine habitat and the historical and current practice of angling in the Owens Basin, it is unlikely that it feasible nor desirable to eliminate them from the Owens Basin, nor would simply curtailing future stocking of these species eliminate them from the Basin.

  Mosquitofish are abundant at Little Hot Creek Pond. It is known that mosquitofish will prey on small individuals of Mohave tui chub (Archdeacon and Bonar 2010), a similar species, but data are not available regarding mosquitofish interaction with the Owens tui chub. Observations over time suggest that the tui chub population at Little Hot Creek Pond appears to continue to reproduce and thrive in the presence of mosquitofish in this location.

  Rainbow trout and brown trout exist within Sotcher Lake and continue to be stocked in that lake by the California Department of Fish and Wildlife (ICF Jones & Stokes 2010).

- **Other natural or manmade factors:** The introduction of Lahontan tui chub and subsequent hybridization and competition are major threats to the Owens tui chub. Although not discussed in the listing rule, stochasticity (random events), catastrophic events, and climate change are also potential threats given the limited distribution of remaining populations.

  - **Hybridization**: Until recently, the Owens tui chub and the closely related Lahontan tui chub were isolated from each other. Lahontan tui chubs were introduced as baitfish into many of the streams in the Owens Basin. This was first observed at Crowley Lake in 1973, where fishermen illegally introduced the Lahontan tui chub (Miller 1973). Since that time, hybridization between the Owens tui chub and Lahontan tui chub has been documented for several populations. At the time of listing, only three populations of genetically pure Owens tui chubs existed, while at the present time, there are six genetically pure populations.

    Using Lahontan tui chubs in the Owens Basin as baitfish is not allowed under fishing regulations set by the State of California. However, Lahontan tui chubs and hybrids are already present in the Owens Basin including Crowley Lake, Hot Creek and tributaries, including Little Hot Creek, and the lower portion of the Owens Gorge. If man-made barriers isolating the Owens tui chub populations at these sites are degraded or removed, this degradation/removal could result in the loss of the pure populations of Owens tui chubs. Currently, the only viable locations for establishing the Owens tui chub are isolated springs or the headwaters of streams with downstream barriers to upstream movement of Lahontan tui chubs or hybrids. Since the Little Hot Creek Pond is close to the national forest boundary, the barriers on Little Hot Creek are primarily water diversion for irrigation off the National Forest System lands that keep the natural creek from connecting with the Owens River.

- **Competition:** Competition with nonnative fish species is a threat to the Owens tui chub. However, little specific information on the impact of competition on the Owens tui chub is available in the literature. Nonnative insectivorous mosquitofish occur at the Little Hot Creek Pond. A major part of the diets for these nonnative species is the same aquatic insects consumed by Owens tui chubs. Although information is not available for rainbow trout completion and predation on this species, mosquitofish are known to affect some southwestern native fishes through competition and predation (Archdeacon and Bonar 2010).
- **Stochasticity:** The creation and maintenance of small, often intensively managed populations have prevented extinction of the Owens tui chub. Species consisting of small populations, such as the Owens tui chub with six isolated populations, are recognized as being vulnerable to extinction from stochastic (random) threats, such as demographic, genetic, and environmental stochasticity and catastrophic events. Demographic stochasticity includes random variability in survival and/or reproduction among individuals within a population. Currently Owens tui chub populations are small; therefore, random events that may cause high mortality or decreased reproduction may have a significant effect on the viability of Owens tui chub populations. In small populations, such as the Owens tui chub, loss of individuals may reduce the amount of genetic diversity retained within populations and may increase the chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to environmental changes and contributes to inbreeding depression (loss of reproductive fitness and vigor) and reduce the viability and reproductive success of individuals. Environmental stochasticity is the variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, or other factors external to the population. Although they generally occur infrequently, catastrophic events, such as severe floods or prolonged drought, can have disastrous effects on small populations and can directly result in extinction. Multiple factors may also act in combination. One possible scenario of how these factors in combination could increase the risk of extinction for the Owens tui chub would be the loss of one or two populations during a drought period at the same time a predator is introduced to one of the remaining populations. Although one or two of the populations may survive and be a source for future reintroductions, the resulting loss of genetic diversity would further increase the risk of extinction.
- **Climate Change:** Impacts to the Owens tui chub under predicted future climate change are unclear. However, a trend of warming in the Sierra Nevada and Inyo Mountains is expected to increase winter rainfall, decrease snowpack, hasten spring runoff, reduce summer stream flows, and reduce ground water recharge. Increased summer heat may increase the frequency and intensity of wildfires. Loss of upland and riparian vegetation leads to soil erosion, increased sedimentation, downcutting of waterways, loss of bank stabilization, and decreased ability of soils to hold moisture and slowly

release it into nearby waterways, all of which would negatively affect Owens tui chub habitat. While northward and/or higher elevation habitats could be important factors in the future conservation of this species, currently the isolated populations of the Owens tui chub are unable to access these habitats because of other threats, including a lack of connectivity of habitats caused by physical barriers (dams and diversion structures); habitat destruction and alteration; and predation, competition, and hybridization with introduced species.

Aquatic Vertebrate Species of Conservation Concern

Fish and Amphibians

The key ecological conditions and key risk factors for these potential species of conservation concern center around aquatic or riparian habitats, even for the terrestrial species. For the one truly aquatic species, California golden trout, the key risk factor is related to sufficient water quantity in occupied streams. The other species are dependent on ponds, springs, seeps, streams or creeks and associated riparian habitats. Severe wildfire and trends in climate change generally have a negative influence on water quantity and quality, and can change the distribution of these limited aquatic and riparian habitats. In addition, they can change where suitable habitats for these species exist on Inyo National Forest. Large changes in habitat can occur due to large areas burned by moderate or high severity fire, or by warming and drying conditions associated with climate change. Low and moderate severity fire effects likely benefit these species by improving vegetation condition and diversity without significantly affecting logs and riparian habitat. Changes can also occur at the local scale such as streambank impacts from livestock, recreation activities, roads, or trails, which can be important for these species with limited populations or limited habitat. For the more terrestrial salamander species ground-based disturbance from a variety of sources could directly impact individuals on the surface or under rocks, logs or forest litter.

Table 65. Aquatic vertebrate species of conservation concern, ecological conditions, and primary stressors and threats to persistence on the Inyo National Forest

Species	Primary Ecosystem Assessment or Habitat Type (s)	Special Habitat Needs/Key Ecological Conditions	Primary Stressors under Forest Service Control	Primary Stressors not under Forest Service Control
Inyo Mountains slender salamander	Riparian Conservation Areas (Springs and Seeps); Sagebrush, Desert Riparian Habitats	Non pool forming seeps. Moist substrates (for egg laying) with riparian vegetation; canyons, solid-rock cliffs, areas where outcrops or talus are in contact with surface flow.	Fire suppression (use of drafting pumps); Grazing/feral burros; and water impoundments (reduction of water flow and increased sedimentation).	Disturbance of permanent seeps/springs associated with stochastic events (drought/flash floods) and climate change; high levels of endemism and naturally limited dispersal ability. Municipal water diversions and alteration of hydrological flow; mining.
Kern Plateau salamander	Riparian Conservation Areas (Springs and Seeps, Perennial Streams, Wet meadows surrounded by mixed conifer (red fir/lodgepole pine) between 4,690 to 9,190 feet	Perennially wet and moist habitat, usually associated with rocky outcrops or rock substrate, along the eastern escarpment of the Sierra Nevada Mountains.	Activities that disrupt water flow (Timber harvest, Fire suppression (use of drafting pumps); Grazing/feral livestock (reduction of water flow and increased sedimentation).	Disturbance of permanent seeps/springs associated with stochastic events (drought/flash floods) and climate change; high levels of endemism and naturally limited dispersal ability. Municipal water diversions and alteration of hydrological flow.
Black toad	Sagebrush and Pinyon juniper, Riparian Conservation Areas (Springs and Seeps-Antelope spring).	Short plant cover providing shaded/cooler environments; unobstructed access to still or slowly flowing water, rodent burrows in winter and shallow marsh and pond waters for breeding.	Vegetation encroachment; Activities that disrupt water flow (Fire suppression-use of drafting pumps); Grazing/feral livestock (reduction of water flow and increased sedimentation).	High endemism, stochastic events (e.g. wildland fire, flash-flooding) that cause changes in timing and flow of water and water availability resulting from climate change and/or municipal water diversions.
California golden trout	Rivers and Streams	Cold clean water with pooling habitat/undercut banks and emergent vegetation. Golden Trout Wilderness (South Fork of Kern River and Golden Trout Creek)	Any activities that alter water flow and hydrologic regime (grazing and water impoundments).	Restricted distribution, genetic introgression and competition from nonnative fish species, endemism/localized extinctions, and stochastic events and drying conditions. Climate change (increased water temperatures and susceptibility to wildlife/sedimentation, reduced snow melt/precipitation).

Black Toad

Status: The black toad is a restricted endemic, limited to several isolated populations in Deep Springs Valley in Inyo County within close proximity to the Inyo National Forest. The predominant population area is located on adjacent, private land. However, the Inyo will continue to provide additional (ephemeral) fringe habitat for dispersing adults. While the ecological conditions the black toad depends on appear generally stable and or trending in a positive direction based on current management, there is still substantial concern for the species persistence by simple virtue of its rarity and uncertain climate change related effects. As a result of this rarity and its limited distribution, this species is highly susceptible to stochastic events and drying conditions resulting from increasing temperatures and climate change. Its limited dispersal ability and isolated populations put it at further risk for localized extinctions and susceptibility to stochastic events.

Threats: Water flow disruption and climate change are threats to the black toad on the Inyo National Forest. Although these threats are largely outside of the control of the Inyo National Forest, the Inyo may contribute to the maintenance of spring sources within Deep Springs Valley, such as Sam's Spring, which has historic artesian wells that maintain the existing habitat. Drying of springs and any activities or processes that disrupt water flow (such as water diversions and dams, in-stream mining, stream capping, feral livestock (burros and cattle), upstream water pumping) would lead to direct mortality (desiccation) and loss of habitat. (Wright et al. 2013) list the black toad as one of the ten most likely species to be affected by climate change. Under their modeling, the black toad could see a reduction in suitable habitat by up to 80% during the forecast period. Additional threats may include disease and geologic action.

Inyo Mountains Slender Salamander

Status: The Inyo Mountain slender salamander is a restricted endemic, limited to several isolated populations scattered throughout a small portion of the Inyo National Forest. It is known from fewer than 20 sites in the Inyo Mountains east of the Sierra Nevada range and there are relatively few recorded observations. Occupied sites are highly localized, springs surrounded by expanses of desert, and apparently isolated from each other. This distributional pattern results in a high potential for extirpations at the site level from stochastic events. Most known populations appear to be stable, although populations may have declined or been extirpated at a few sites due to habitat modification.

Threats: As a result of its rarity and its limited distribution, this species is highly susceptible to stochastic events such as drying conditions which may become more frequent with climate change. The Inyo salamander's limited dispersal ability and isolated populations put it at risk for localized extinctions. The Inyo Mountains salamander is restricted to spring habitats so any impact that influences stream flow (including duration and quantity) would likely threaten population persistence. Past impacts to stream flow and riparian areas include the capping of springs, diversion of stream flow, in-stream mining, and disturbances to riparian areas from feral livestock (burros and cattle). This species is also vulnerable to climate change and any changes in precipitation patterns that influence spring discharge would likely result in a decrease in available habitat. (Wright et al. 2013) modeled that up to 50 percent of the suitable habitat could be reduced by 2050 as a result of anticipated changes to climate.

Kern Plateau Salamander

Status: The Kern Plateau salamander is highly endemic and is largely restricted to the Kern Plateau and western portions of Owens Valley. This species occurs in perennially wet and moist habitat, usually associated with rocky outcrops or rock substrate, along the eastern escarpment. In the drier portions of its range, the spring and riparian habitats it occupies are fragile and vulnerable to damage.

Threats: The Kern Plateau salamander occurs in areas of permanent or seasonal surface moisture. Any activities that limit these microsite conditions could negatively affect the species. This includes management activities such as road construction, timber harvesting, fire suppression and habitat degradation through capping of springs or alterations of spring water or habitat. Habitat on the Inyo National Forest may be naturally limited and increased wildland fire events coupled with subsequent flash-floods that scour habitat are also potential risk factors. Persistence of the salamander populations may be closely tied to climate variations that affect their habitat, especially if they experience extreme drying trends, or stochastic events such as flash floods.

California Golden Trout

Status: The California golden trout is an endemic fish species, limited to a small portion of suitable habitat on the Inyo National Forest. The California golden trout is native to Golden Trout Creek and the South Fork Kern River in the upper Kern River basin (Moyle 2002). Because the range of the trout has been severely reduced and is limited to two watersheds, this distribution makes the California golden trout vulnerable to stochastic events that can lead to localized extirpations or reductions in population size. Smaller populations are subsequently vulnerable to inbreeding which can influence long-term adaptability to changing environmental conditions.

Threats: Hybridization with rainbow trout, competition and predation from nonnative trout, grazing, recreation, limited distribution, and climate change.

The primary threats to California golden trout are hybridization with rainbow trout and competition and predation by brown trout (Moyle 2002) (Stephens, McGuire, and Sims 2004). Hybridization undermines the unique genetic integrity of the golden trout which may result in a loss of locally adapted genes to the species (Stephens, McGuire, and Sims 2004). Brown trout compete and prey upon the golden trout, even to the point of local extirpations. The California Department of Fish & Wildlife and the Forest Service have worked cooperatively to improve conditions for golden trout including removal of obviously hybrid fish, the establishment of barriers to prevent the upstream movement of fish other than golden trout, and the planting of sterile rainbow trout in popular recreational fisheries in close proximity to occupied golden trout waters (Stephens, McGuire, and Sims 2004). Grazing is another primary threat to the continued existence of golden trout (Moyle 2002) (Knapp and Vredenburg 1996) (Stephens, McGuire, and Sims 2004). Overgrazing may cause impacts to riparian and bank structure thereby affecting the instream habitats the trout rely upon. Climate change has the potential to further reduce the range of the California golden trout, primarily through increased water temperatures. The impact of recreation on the California golden trout is relatively minor; however, human activities can result in impacts to stream and riparian features and result in the reintroduction of undesirable fish species into occupied golden trout waters.

Aquatic Invertebrate Species of Conservation Concern

Table 66. Aquatic invertebrate species of conservation concern ecological conditions, and primary stressors or threats to persistence on the Inyo National Forest

Species	Primary Ecosystem Assessment or Habitat Type (s)	Special Habitat Needs/Key Ecological Conditions	Primary Stressors under Forest Service Control	Primary Stressors not under Forest Service Control
Western Pearl shell	Rivers and Streams	South Fork-Kern River; cold, clean water where sea-run salmon or native trout persist (documented host fish species critical to life cycle).	Activities such as grazing, water impoundments, dredging, and road construction that affect in stream flow hydrology and increase sedimentation.	Climate change (increasing water temperatures) is primary environmental stress. Anthropogenic stressors include municipal water diversions and related actions that reduce/alter hydrologic regimes including mining operations and suction dredge activities (regionally relevant, no mining or suction dredging within Inyo NF Pearl shell habitat).
Wong's springsnail	Springs and Seeps	Uses escarpments of the White and Inyo mountains on the east side of the Owens Valley. Cold spring water sources with perennial flow.	Activities such as grazing, water impoundments, dredging, and road construction that affect in stream flow hydrology and increase sedimentation.	High endemism/restricted distributions and limited dispersal ability; stochastic events (e.g. wildland fire, flash-flooding) that cause changes in timing and flow of water and limited water availability resulting from climate change and/or municipal water diversions and ground water withdrawals.
Owen's Valley Springsnail	Springs and Seeps	Cold spring water sources with perennial flow.	Activities such as grazing, water impoundments, dredging, and road construction that affect in stream flow hydrology and increase sedimentation.	High endemism/restricted distributions and limited dispersal ability; stochastic events (e.g. wildland fire, flash-flooding) that cause changes in timing and flow of water and limited water availability resulting from climate change and/or municipal water diversions and ground water withdrawals.

Springsnails require undisturbed springs. Even small water developments or disturbances can limit the ability of these species to use the area. Climate change is a substantial risk factor for many of these species because they have very limited distributions, and frequently disjunct populations. Springsnails are dependent on seeps and springs which can be affected by changed precipitation patterns.

Western Pearlshell Mussel

Status: The western pearlshell has a broad distribution; however, it is in decline in most of its range and has been extirpated from many known localities. The causes for these declines, although not completely clear, are associated with anthropogenic changes to habitats that either influence physical habitat features or the fish hosts that the mussels rely upon for successful reproduction. Despite the broad distribution of this species throughout the western states, its decline has led to limited localities on the Inyo National Forest. On the Inyo National Forest, the ecological conditions necessary for western pearlshell can be found in the South Fork Kern River and similar river systems, especially where the host fish species occur. Many western pearlshell populations are no longer recruiting new individuals or the recruitment levels are very low and, in some cases, die offs have been observed (Howard and Cuffey 2006; Hastie and Toy 2008; Howard 2008; Jepsen, LaBar, and Arnock 2012).

Threats: River or stream impoundments probably have had the greatest impact on western pearlshell populations because hydropeaking water releases interrupt streamflow patterns (including timing, volume, and temperature), channel morphology, and influence the presence and density of host fish species. Many types of channel alteration can affect the stability of the streambed where mussels occur including suction dredge mining, gravel extraction, and channel dredging. If these activities occur in or in close proximity to pearlshell beds, the streambed may become unstable and detrimental changes to the channel can occur with effects to water velocity, water depth, and protection from increased shear stress. Because clear, cold water is a key habitat element required by the pearlshell, climatological changes that result in reduced streamflow, increased water temperatures, or both, may result in a further reduction in suitable habitat for the mussel or appropriate fish hosts. (Vannote and Minshall 1982) and Howard and Cuffey (2006) attributed increased sediment with declines in *M. falcata*, implicating in-channel dredging, logging, and livestock use in the affected watersheds.

Wong’s and Owens Valley Springsnails

Status: The springsnails of conservation concern are restricted endemics with few known locations on the Inyo National Forest. Each population of springsnail is endemic to the spring it inhabits, and since these snails are obligatory aquatic throughout their entire life, they cannot disperse to other springs, nor can springs where snails have been extirpated be recolonized. Both species occur at Batchelder Springs. There is substantial concern for the species persistence due to its rarity and restriction to cold perennial springs and seeps. As a result of this rarity and its limited distribution, these species are highly susceptible to stochastic events and drying conditions resulting from increasing temperatures and weather events related to climate change.

Threats: Threats include any activities that alter microsite conditions at perennial water sources. Activities such as overgrazing or water diversion projects may degrade or eliminate springsnail habitat. Excessive sedimentation from a variety of activities such as logging, mining, road and railroad grade construction, and overgrazing may smother substrates causing death by preventing feeding and movement, and obstructing gills (Vannote and Minshall 1982, Hovingh 2004, Webb, Craft, and Elswick 2008, Bettaso and Goodman 2010). Additionally, water quality (temperature) and climate change are considered key risk factors.

Environmental Consequences to At-risk Aquatic Species

Consequences Common to all Alternatives

All alternatives contain protective measures, both through plan language and compliance with Endangered Species Act requirements that will generally protect aquatic species from direct effects of national forest management activities.

All alternatives would retain riparian conservation areas with direction that protects aquatic habitats by providing guidance for protecting aquatic and riparian species during ground-disturbing management activities in riparian areas. Projects, guided by desired conditions, would implement standards and guidelines, including equipment limitations close to water and riparian vegetation. Established best management practices to protect water quality would be applied to all ground-disturbing projects (USDA Forest Service 2011d, 2013a). Best management practices are expected to benefit aquatic species habitat on a forestwide scale. The Inyo National Forest would continue to follow agency direction to implement an annual best management practices evaluation and adaptive management program, following established agency monitoring protocols.

All alternatives would promote priority watershed restoration focused on maintaining or improving watershed conditions using the national Watershed Condition Framework as funding permits. Additionally, restoration of aquatic ecosystems is a regional priority as outlined in the "Ecological Restoration Leadership Intent" established by the Regional Forester (USDA Forest Service 2015g). The Inyo National Forest, with help from partners, is actively implementing restoration actions to reduce erosion on roads, trails, dispersed camping areas, grazed areas, and other developed and dispersed recreation sites. These efforts are expected to continue under all alternatives, resulting in improved water quality and improved aquatic habitat conditions by reducing erosion and improving and restoring degraded areas.

Effect to aquatic species from livestock grazing will not vary by alternative, because the alternatives would have the same livestock management approach as under the current plan. Under all alternatives, grazing will be managed specifically to avoid negative effects to aquatic species through trampling standards, range readiness standards, utilization standards, and other protective measures. All permits contain language that livestock will not enter the allotment prior to range readiness. Within the plan area, California golden trout and the Mountain and Sierra yellow legged frog overlap with active allotments. Typically, spawning and egg-laying timing coincides with spring melt-off in suitable habitats and is a consideration addressed in determining the timing of "range readiness," for grazing (see "Production Livestock Grazing" section).

Operations of dams, water diversions and groundwater extraction would continue under all alternatives, and there would be no difference in management of these water uses by alternatives. Therefore, effects to at-risk aquatic species would not vary by alternative. Under all alternatives, the Inyo National Forest would continue to work with partners such as the Federal Energy Regulation Commission and water users to minimize effects of these activities on species. However, many of these effects are largely outside the control of the Forest Service, and therefore dams and diversions will continue to have major effects to aquatic habitat and species on the Inyo, through affecting stream and spring flow. Effects to many of the at-risk species, such as

Yosemite toads and yellow-legged frogs, are largely unaffected by these activities because their habitat is upstream of almost all diversions and dams on the national forest.

Although on-the-ground vegetation treatments are expected to have a variety of long-term benefits, there is potential for short-term effects during and immediately following project implementation. In general, alternatives that manipulate more habitat would translate into more potential for disturbance to aquatic species and temporary disturbance to aquatic habitat conditions from the use of equipment or fire, until the habitat recovers. Treatments to improve fire resilience in both upland and riparian ecosystems over the long term would mitigate the short-term impacts to water temperature, riparian vegetation and other components that provide quality habitat for aquatic species. Alternatives that treat more areas would provide greater long-term benefits by restoring ecosystem integrity more aligned towards the natural range of variation that would be expected to provide greater resilience and greater sustainability of ecosystem functions of aquatic systems.

General Consequences of Alternative A

The aquatic management strategy would continue to be used to manage riparian habitats according to the riparian conservation objectives to maintain the ecology of riparian areas to buffer sediment from entering aquatic habitats. Standards and guidelines in the current plans emphasize protecting water quality and protecting riparian conservation areas by limiting active management within a variable buffer distance around riparian features. There is some ability to restore riparian vegetation structure and composition in alternative A but it is limited by restrictions on mechanical treatments within riparian conservation areas. The number of critical aquatic refuges would remain unchanged, so some watersheds containing refugia or concentrations of rare species would remain outside of a critical aquatic refuge. Because riparian conservation areas include most primary habitat for these species, their habitat has the same protections as critical aquatic refuges, but over a smaller area. The existing direction is sufficient to protect these species from direct project impacts, but does not protect against indirect impacts of future large fires as well as the plan revision alternatives.

Direction under this alternative has allowed for improvements to stream habitats by reducing erosion risk with actions such as decreasing trail and road density in riparian areas and meadows and removing or mitigating effects of dispersed camping from the edges of meadows and streams. Alternative A proposes the fewest number of meadows maintained, enhanced or improved and has some of the most restrictive constraints on use of restoration tools. Few areas would have conifers removed to restore more open meadow habitats. This alternative leaves meadow, seep, and spring habitats more vulnerable to wildfire outside the range of natural variability.

All alternatives allow removal of vegetation through hand thinning, mechanical treatments, prescribed fire, and wildfire managed to meet resource objectives as a means to improve the resilience of vegetation to stressors and move vegetation and ecosystem functions toward the natural range of variation. However, alternative A has the smallest acreage for prescribed and managed fire, and does not focus on reducing uncharacteristically large fires on a landscape scale. Therefore, the Forest will likely continue to have increased sediment from these fires, such as occurred after the O’Harrel fire in Lahontan cutthroat trout habitat.

The desired conditions under the current management approach do not specifically consider climate change or climate-related stressors. Without addressing climate change stressors and the influence of various adjacent ecosystems on a larger landscape scale, this alternative makes it more difficult for projects to strategically protect and improve the condition of riparian habitat than the other alternatives.

Alternative A includes some treatment restrictions within riparian conservation areas and critical aquatic refuges, which limits the extent of aquatic and riparian habitat restoration by preventing lighting of prescribed fires within riparian conservation areas or critical aquatic refuges. Improvement of aquatic habitat conditions is primarily related to mitigating the effects of sediment from roads, and addressing hydrologic connectivity from road culverts and stream crossings. While hydrologic connectivity is addressed generally under this alternative, maintenance of aquatic habitat connectivity was only emphasized for some aquatic species, primarily trout. Restoration of aquatic habitat connectivity by improving road crossings or mitigating water diversions would be expected to occur at a slow pace. Under this alternative, the limited implementation of restoration is expected to leave many areas containing native at-risk aquatic species untreated and vulnerable to increased sediment input from uncharacteristically large fires.

Restrictions on mechanical treatments also limit the ability to adequately reduce fuel volumes in riparian conservation areas to safely incorporate prescribed fire and reduce the threat of wildfire spread in riparian habitats. Additionally, prescribed fire restrictions in riparian areas limit direct fire ignitions, which reduce the ability of fire managers to create a patchy mosaic within riparian areas to lower the risk of riparian vegetation burning at high intensity during wildfires. There is less control of fire intensity and spatial burn patterns when fire is only allowed to back down into riparian areas compared to fire managers using direct ignition methods to more closely control the fire burn patterns and fire behavior. Lack of managed fire ignitions in this habitat restricts the ability of fire managers to control how the fire behaves and create a patchy mosaic of low and moderate-severity fire effects. Although managed wildfire is considered a tool under this alternative, the unnaturally dense vegetation conditions of many riparian habitats and mechanical treatment restrictions make the use of this tool for the benefit of riparian habitat improvement unlikely in most situations, except in the higher elevation areas.

Given the limited amounts of fuel reduction treatment, this alternative does not substantially improve the resilience of the overall landscape to wildfire. The burned area under this alternative is predicted to increase two to four times compared to alternatives B, B-modified and D, and much of the change would be in increasingly larger fires that are predicted to have large patches of high-intensity and high-severity fire (see the “Fire Trends” section), which is more likely to remove large areas of riparian vegetation (Elliot, Miller, and Audin 2010). High-severity fire can dramatically increase overland water flow and peak flows, triggering severe flooding and erosion (DeBano et al. 1998, Neary et al. 2005). High-severity wildfires increase runoff and erosion rates by two or more orders of magnitude (Elliot, Miller, and Audin 2010). Therefore, under this alternative, more acres of aquatic habitat remain at risk of being adversely affected by the increasing trend in large, high-intensity wildfire and the resulting increases in surface erosion and sediment delivery to aquatic habitats.

General Consequences Common to Alternatives B, B-modified, C, and D

Current forest plan direction for invasive species is focused primarily on invasive plants and does not explicitly address other invasive species. For alternatives B, B-modified, C, and D, direction is expanded to include terrestrial and aquatic invasive species through forestwide guidance to control, or eradicate when possible, and prevent establishment of new populations of aquatic invasive species. Riparian conservation area desired conditions include direction to work with

State and Federal wildlife agencies to reduce impacts of invasive species to native aquatic species populations. All plan revision alternatives include forestwide direction to clean equipment when moving from waterbodies with known aquatic invasive species thus reducing risk of invasive species becoming established (INV-FW-STD-01).

All plan revision alternatives provide direction for aquatic ecological restoration and attempt to mitigate effects of climate change at varying scales. They include goals to mitigate climate effects through riparian vegetation and aquatic system restoration to maintain or reduce water temperatures and prevent erosion for the benefit of at-risk aquatic species.

General Consequences of Alternative B

Alternative B is anticipated to improve aquatic habitat conditions at the landscape scale. The increased pace and scale of restoration treatments under this alternative, along with a focus on landscape-level improvements and an emphasis on prescribed fire and wildfire managed to meet resource objectives is predicted to result in forest landscapes with a stronger resilience to large, high-intensity fires. The ability to use more mechanical treatments and natural fire tools under this alternative translates into a greater ability to adapt to climate change than alternative A. The focus on a landscape treatment approach, combined with riparian conservation area direction, is designed to reduce the negative effects of wildfire on aquatic habitats more effectively than the scattered treatment approach of alternative A and the limited treatment approach of alternative C.

Alternative B proposes to designate one additional critical aquatic refuge to protect additional at-risk aquatic species habitats. The direction for managing critical aquatic refuges is similar to alternative A. Although additional designation may be a benefit, more critical aquatic refuges do not necessarily translate into improved aquatic habitat conditions within the designations. Restrictions on treatment options and constraints on the use of restoration tools would continue to limit some restoration opportunities which could reduce the potential to build adaptive capacity to climate change for some at-risk species.

The additional critical aquatic refuge identified surrounds a population of black toads. This additional critical aquatic refuge would add some minor protections for the toad relative to alternative A. Additionally, strengthened direction for management of at-risk species and upland portions of watersheds is strengthened forestwide, and applies to all watersheds would improve protection for black toad habitat.

Alternative B proposes to maintain, enhance or improve more meadows than alternative A, a similar number of meadows as alternative D, and fewer meadows than alternative C. Riparian and meadow vegetation restoration under this alternative would be for the purpose of moving vegetation toward desired conditions and would be intended primarily to restore native species composition, heterogeneity, resilience, and reduce the ingrowth of conifers and shrubs. Removal of conifer species in meadow habitats, particularly lodgepole pine, can increase the water table and provide better wet meadow, seep and spring habitat conditions. Increased standing water in meadow habitats would improve the vegetation structure and complexity, thereby improving habitats for at-risk aquatic species. The end result of the treatments under this alternative would generally be improved riparian hardwood composition and structure, increased herbaceous density, vigor and structural complexity, and increased amounts of surface water.

Alternative B includes an increased emphasis on partnerships to accomplish meadow restoration. Under this alternative there is also greater potential for stewardship funding to address meadow and riparian restoration work.

This alternative manages the same riparian conservation areas as alternative A and uses the full suite of plan components (desired conditions, standards and guidelines, goals) to better move riparian ecosystems toward resilience to fire and climate change. The management approach under alternative B proposes to maintain, enhance, or improve more acres of riparian habitat than alternative A and with a greater variety of restoration tools including mechanical thinning, prescribed fire, and wildfire managed to meet resource objectives.

Alternative B modifies direction in alternative A by allowing more flexibility to use prescribed burning and more mechanical and hand treatments to improve riparian resilience to fire, drought and climate change. Although mechanical equipment use in riparian habitat could occur under this alternative, these treatments would be for the purpose of reducing high fuel loads to prepare riparian areas to be treated by prescribed fire methods. Overall, over the long term, these restoration actions are anticipated to result in providing more productive site conditions, which would result in improved aquatic habitat conditions.

Alternative B also allows for direct ignition of prescribed fire in riparian areas which is predicted to greatly improve the resilience of riparian habitats because fire is introduced back onto the landscape in a controlled and purposeful way. All restoration that results in a reduction of upland conifers in riparian areas would restore riparian vegetation composition and structure. This would increase sunlight for riparian hardwoods and shrubs that are often shaded out by upland trees and shrubs. Prescribed fire and wildfire managed to meet resource objectives would improve the condition, vigor and health of most native riparian plants that support a variety of riparian system functions. Increased structural diversity of these habitats would enhance use by a variety of species strongly associated with complex understory and overstory. Increased fire would result in increased sprouting of native vegetation, and improved health, condition, and vigor of hardwood and understory plants, including host plants for a variety of invertebrates. The trend in composition and structural heterogeneity of native species would increase under this alternative.

General Consequences of Alternative B-modified

In alternative B-modified, critical aquatic refuges are not identified. All existing critical aquatic refuges would be eliminated. Elimination of critical aquatic refuges would not result in fewer protections for at-risk aquatic species. Plan components addressing specific at-risk species, and forestwide upland components that would apply to all watersheds, along with riparian conservation area direction that is the same under all alternatives, would maintain or increase protection of these species relative to alternative B.

Conservation watersheds are associated with several populations of at-risk species and areas that are priorities for aquatic and riparian restoration. They were designed to address landscape-scale processes, to maintain functionality of watersheds, and not just focus on a small species-specific area. The effects should be a more widespread improvement to habitat conditions, providing greater resilience to the effects of stochastic events by allowing for greater species dispersal and more areas providing refugia to these species. When coupled to forestwide watershed, riparian conservation area, and stronger species plan components, each operating at different scales, it is expected that the overall approach will have positive effects on species viability and persistence.

The consequences of differences in managing for critical aquatic refuges in alternatives A, B, C, and D and conservation watersheds in alternative B-modified is described in the species-specific sections below and discussed in the Conservation Watershed white paper in the project record.

General Consequences of Alternative C

Alternative C proposes to reduce high-intensity fire risk by increasing the use of prescribed fire and wildfire managed to meet resource objectives, instead of mechanical treatments. The pace and scale of treatments are not sufficient to reduce the long-term negative effects from high-intensity wildfire across the landscape. Since climate change is likely to increase the risk of high-intensity wildfire, overall watershed function would decline under alternative C (see "Fire Trends" section).

Alternative C proposes to designate 8 additional critical aquatic refuges on the Inyo National Forest. Therefore, there would be protection of more aquatic habitat in these designated areas than under alternatives A and B. Overall this is viewed as a positive improvement over alternatives A and B but not without potential negative short-term consequences. As described under alternative B, restrictions on treatments in these areas could unintentionally prevent needed restoration work that removes or mitigates stressors within these systems.

Riparian and aquatic restoration work to help offset impacts of climate change on stream temperatures and availability of water would likely be limited to existing and new priority watersheds and to completing essential projects within those watersheds. The riparian element would not likely change in the short term but would decline over the long term due to the limited pace and scale of ecological restoration of adjacent uplands, except where restoration of riparian structure and native species occurs.

Since alternative C does not limit watershed restoration and could use additional sources of funding and assistance through partnerships to address aquatic habitat conditions, the pace and scale of meadow restoration may increase relative to alternative A.

This alternative proposes to maintain, improve, or enhance the most meadows. More restoration is proposed because hand equipment, prescribed fire, and wildfire managed to meet resource objectives may more rapidly treat smaller meadows with less severe conifer encroachment, invasive species, and issues related to water retention. In contrast, alternative B may treat larger meadows with more complex issues because mechanical treatments can be used as a precursor to burning. Alternative C emphasizes the use of prescribed fire and wildfire managed to meet resource objectives to accomplish restoration and proposes to use more prescribed fire and managed wildfire than alternative A. Therefore, the treatments under this alternative have a greater potential than alternative A, but less than B to restore or improve meadow habitat conditions. This could provide slightly greater improvements to habitat conditions for at-risk species dependent on shallow groundwater than alternative A.

Although there is less potential for short-term, implementation-related impacts under this alternative because of fewer mechanical treatments, there could be long-term negative impacts on habitat conditions because of the treatment limitations compared to the other plan revision alternatives.

Alternative C does not modify direction to allow flexibility to use more prescribed burning, mechanical treatments, or hand treatments for riparian resilience to fire, drought, and climate change. Under this alternative, the use of prescribed fire to treat riparian areas would be constrained because of species-specific protections (not a landscape approach) and excessive fuel loading in riparian areas that could not be treated with mechanical treatments before using prescribed fire. This alternative has the most area with a passive management approach with potential for repeated prescribed fire treatments in riparian areas. This alternative does not treat at the landscape scale, making habitat patches more vulnerable to a variety of stressors adjacent to riparian zones, including loss from wildfire, ingrowth of conifers from adjacent upland units, and spread of invasive species. This alternative has a lower ability than alternative B to move the landscape toward resilience to climate change and continues to have a low resiliency to large high-intensity wildfire. As a result, aquatic habitat under this alternative would be at a greater risk to degradation from untreated stressors and large-scale disturbances.

Similar to alternative A, this alternative does not substantially improve the resilience of the overall landscape to wildfire given the limited amounts of fuel reduction treatment. This alternative treats only a small proportion of the lands needing treatment to substantially reduce the risk of large-scale high-intensity wildfires. The burned area under this alternative is predicted to increase and result in increasingly larger fires with large patches of high-intensity and high-severity fire (see “Fire Trends” section). This is more likely to remove large areas of riparian vegetation (Elliot et al. 2010), dramatically increase overland water flow and peak flows, and potentially trigger severe flooding and erosion. Therefore, under alternative C, more acres of aquatic habitat and the condition of that habitat is anticipated to be adversely affected by the increasing trend in large, high-intensity wildfire and the resulting increases in surface erosion and sediment delivery to aquatic habitats.

General Consequences of Alternative D

Under this alternative, the critical aquatic refuges and plan direction and effects would be the same as in alternative B. More opportunities exist for implementing watershed restoration projects than in any other alternative, which results in increase in overall long-term ecological restoration. More treatment within watersheds should reduce the acreage that wildfire burns at high severity, would make the landscape more resilient to climate change, and in the long term, achieve the greatest improvements to aquatic habitats than any other alternative.

The emphasis on low- and medium-intensity fires across the landscape including within the riparian areas limits the accumulation of fuels, and encourages healthy functioning aquatic habitats and therefore, the long-term potential for indirect impacts of sediment flows to streams from wildfire is lower than all other alternatives considered in detail (See “Fire Management” section).

Under alternative D, water quality and aquatic habitats would be improved where restoration of watersheds occurs, especially in meadows and associated riparian areas. This alternative would provide the most improvements to groundwater storage, base flows, and surface water due to slightly higher infiltration rates across the landscape. This in turn would result in lower water temperatures during the dry season. Encouraging shallow groundwater storage potentially mitigates some of the impacts from climate change by increasing aquatic ecosystem resilience, providing more stable stream flows, and benefitting aquatic species dependent on springs.

Alternative D would maintain, enhance, or improve more meadows than alternative A and would be the same as alternatives B and B-modified. Restoration of meadows and aquatic systems and protection of aquatic habitat would improve resilience as in alternatives B, B-modified, and C but on an increased number of acres under alternative D. Alternative D would allow increased use of mechanical equipment in the riparian conservation areas to improve conditions. By treating more areas, alternative D would reduce the risk of uncharacteristically large wildfires more than the other alternatives, thus reducing the risk of undesirable short-term impacts to aquatic habitats from high-intensity wildfire while still allowing for the historically beneficial role of fire to be expressed. Increased fire resilience would result in long-term benefits to watersheds and riparian areas more than all other alternatives.

An increase in ecosystem restoration could have short-term negative consequences to aquatic species, particularly where mechanized treatments are used to restore riparian vegetation. This alternative may have short term impacts for aquatic species habitats from ground-disturbing activities. These short-term consequences on riparian species diversity are balanced favorably against the long-term benefits of creating more sustainable landscapes that have more resilience to changes from wildfire, climate change, and other stressors.

Species-specific Consequences

Sierra Nevada and Mountain Yellow-legged Frogs (Endangered)

Consequences Common to All Alternatives

The majority of the designated critical habitat for the mountain yellow-legged frog and Sierra Nevada yellow-legged frog in the Inyo National Forest plan area is within designated wilderness areas. Within designated wilderness, active, ground-disturbing management, such as direct vegetation management, prescribed burning, and habitat restoration, generally would not occur. However, habitat restoration specifically designed for frogs may occur and could occur using the same methods and in the same areas under all alternatives. Within designated wilderness, since direct restoration of habitat involving ground-disturbing action will be limited, the primary means of achieving restoration of aquatic habitats will be passive managing actions or small-scale restoration such as moving trails away from breeding habitat.

Livestock occurs in only one area currently occupied by Sierra Nevada yellow-legged frog and mountain yellow-legged frog on the Inyo, in the Mulkey Allotment in the area around Mulkey Meadows, which could affect the mountain yellow-legged frog. There is current livestock grazing in designated critical habitat.

None of the alternatives directly change the status or use on individual allotments, nor do they substantively change current direction for livestock grazing. As described elsewhere, in the plan revision alternatives, process-related language is removed from the forest plan and is issued as supplemental implementation guidance so it can be kept more current as protocols improve with better knowledge. This change for administrative purposes is not expected to change any on-the-ground action or activity related to livestock grazing and would not differ by alternative. These guidelines should continue to protect habitat for both yellow-legged frog species under all alternatives.

Other than fire management, habitat within critical habitat areas, largely within wilderness, will remain essentially undisturbed by management activity, but meadows and streams used by these species may be exposed to periodic, low-level, recreational use by individuals, small groups of hikers and recreational pack stock. Current use levels collected during wilderness permit issuance show that use is low to moderate and has decreased over past historic levels. Under all alternatives, within designated wilderness, if the level of recreation use were found to be adversely impacting these species, the plan provides guidance to mitigate the effects.

Within the small areas outside of wilderness in the Evolution/Le Conte critical habitat subunit for Sierra Nevada yellow-legged frog, recreation activities are expected to continue because of the road access. There are no known conflicts with recreation at these sites.

There are no effects from roads and other infrastructure that would affect the northern distinct population segement of the mountain yellow-legged frog because all occupied habitats and critical habitats are located within designated wilderness. Within the portion of the Evolution/Le Conte critical habitat unit for the Sierra Nevada yellow-legged frog, road maintenance would occur as needed along the existing roads. However, any road maintenance activities in this area would be designed to avoid, mitigate, or minimize effects to the Sierra Nevada yellow-legged frog and consultation would occur if any project may affect the species or its habitat. Because of the proximity to Baker Creek and other streams in the area, additional direction to protect riparian conservation areas would also apply to many road related activities that might be proposed.

Consequences Specific to Alternative A

Alternative A does not define specific forest plan direction regarding fire management strategies outside of the wildland-urban interface that address at-risk species. However, national forest staff can evaluate naturally ignited wildfires on a case-by-case basis to determine if they could be managed to meet resource objectives. Because the emphasis is not on landscape-scale natural fire regimes, habitat, alternative A is the least likely to return natural fire to the landscape within yellow-legged frog habitat, and long-term effects of fire suppression will likely continue, including increased risk of uncharacteristically large fires and subsequent increase in sediment input into habitat.

Consequences Common to Alternative B, B-modified, C, and D

In designated wilderness, the desired condition for the two yellow-legged frog species will primarily be attained through managing wildfires by considering the expected fire effects on habitats and striving to maintain and restore fire as an ecological process. While managing wildfires to meet resource objectives is also allowed under alternative A, resource objectives in the forest plan would be more clearly defined in alternatives B, B-modified, C and D, thus making it simpler to evaluate and manage selected wildfires that are appropriate for this strategy. Effects to yellow-legged frog species will be considered when determining whether to manage wildfires for resource protection, and improve overall watershed resilience to stochastic events, therefore improving the long-term habitat condition for the frogs.

Only a small portion of critical habitat for the Sierra Nevada yellow-legged frog occurs outside of the John Muir Wilderness on the Evolution/Le Conte critical habitat unit in the Coyote Flat area. This area has mostly shrub or sparse subalpine conifers, and would not likely have mechanical vegetation treatment. Therefore, though there could be more mechanical treatment throughout the Forest, it is unlikely to lead to a difference in effects to either yellow-legged frog species between the plan revision alternatives.

Consequences Specific to Alternative B-modified

Alternative B-modified could have slightly different effects to yellow-legged frog species due to conservation watersheds being used, and no designation of critical aquatic refuges. This could slightly improve overall watershed condition due to a holistic management direction for the conservation watershed allowing for greater resilience to climate change and stochastic events. However, because almost all critical habitat for these species is within designated wilderness, the management within critical habitat will have few, if any, differences.

Yosemite Toad (Threatened)

Consequences Common to All Alternatives

The majority of the designated critical habitat for the Yosemite toad on the Inyo National Forest is within designated wilderness areas. In these areas, active, ground-disturbing management, such as direct vegetation management or prescribed burning would occur in very limited situations, if at all. In designated wilderness, the desired condition for Yosemite toad will primarily be attained through guiding decisions related to managing wildfires by considering the expected fire effects on habitats to provide benefits for resources and striving to maintain and restore fire as an ecological process. While this primary approach is common across the alternatives, there are some differences in the plan direction for how and where fires are managed and this will be evaluated more specifically by alternative.

Other than fire management, habitat within wilderness areas will remain essentially undisturbed by management activity, but meadows and streams used by these species may be exposed to periodic, low-level, dispersed wilderness travel, by individuals and small groups of hikers primarily on trails. Recreationists are often attracted to meadows and viewing and photographing wildlife is a substantial attraction. If recreation disturbances were found to be causing an adverse effect, under all alternatives, the Inyo staff would work with the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to determine what mitigations might be needed.

Recreational pack stock use could impact individuals or habitats if it occurs in breeding and rearing habitat prior to metamorphosis. Current pack stock use levels across the national forest, collected during wilderness permit issuance, show that use is low to moderate and has decreased over past historic levels. Commercial pack stock use is prohibited by a court order that restricts pack-stock grazing in occupied Yosemite toad breeding and rearing habitat through the time of toad metamorphosis. This is not expected to change, and if there were changes, there would be required subsequent environmental analysis and would not vary by plan alternative. These restrictions are consistent with the forestwide plan direction to consider project timing for projects that may affect occupied habitats for at-risk species.

The risk of adverse effects to critical habitat occurs primarily in the small portion of critical habitat located outside of designated wilderness around Lake Mary. In this area, active suppression of wildfires might occur to protect life and property, and this is unlikely to vary by alternative in this area heavily used for recreation. Active fire suppression could result in some risk of adverse effects but would be subject to emergency consultation to minimize effects. Similarly, there could be a need and opportunities for vegetation and fuels management to reduce fire risks and to provide for public safety given the heavy recreation use that occurs in this area; however, this would not be likely to adversely affect critical habitat as there is plan direction that provides for riparian conservation areas that would apply to meadows and projects that occur in critical habitat or that could affect Yosemite toads would require consultation with the U.S. Fish and Wildlife Service. Restoring fire to the ecosystem would benefit critical habitat by reducing the risk of post-fire sediment affecting aquatic habitats.

If restoration or other project activities are proposed around meadows and ponds occupied by Yosemite toads, they would be guided by direction for riparian conservation areas to maintain or improve the ecological conditions that contribute to the recovery of threatened and endangered species and would be designed to include design features, mitigation, and project timing considerations that would avoid, minimize, or mitigate effects to occupied habitats. The Inyo

National Forest would continue to consult with U.S. Fish and Wildlife Service on all site-specific projects under all alternatives.

The use of pesticides within critical habitat and occupied habitat would continue to be limited for treatment of invasive plant species, and possible treatment within campgrounds for vector control of disease from rodents. In all cases, plan direction requires that any pesticide application within 500 feet of known occupied Yosemite toad sites would avoid adverse effects to individuals or their habitats and future projects would require compliance with section 7 of the Endangered Species Act and consultation with the U.S. Fish and Wildlife Service as needed.

Outside of designated wilderness there are existing roads around Lake Mary but no roads around the other occupied sites (Crystal Lake and T.J. Lake). Since the area around Lake Mary has heavily used existing developed recreation facilities, roads will likely be maintained to a standard that supports the higher use levels, similar to the current condition. Although alternative B-modified identifies this area as a destination recreation area where management of impacts from recreation would be greater than other areas on Inyo National Forest, that designation would not change on-the-ground conditions relative to the current situation. Currently, recreational activities are not known to be negatively affecting current Yosemite toad populations, and that will continue under all alternatives. All alternatives would manage sites and activities to avoid, mitigate, or minimize effects to federally listed species and to contribute to the recovery of the species. Thus, consequences of road use on Yosemite toad is not expected to vary by alternative, especially since use of these roads are not known to be a current mortality factor.

Consequences Specific to Alternative A

Alternative A does not define specific forest plan direction regarding fire management strategies outside of the wildland-urban interface that address at-risk species. The Inyo would evaluate naturally ignited wildfires on a case-by-case basis to determine if they could be managed to meet resource objectives. This would occur in the majority of occupied habitats and critical habitat located within designated wilderness. To the extent that fire is restored to these higher elevation landscapes, it will reduce the likelihood of future wildfires burning outside of the natural range of variation which will reduce the potential for post-fire sediment impacts.

The portion of critical habitat outside of designated wilderness near Lake Mary is within the WUI defense and threat zones where fuels treatments and fire suppression are expected to protect human assets. However, because of the high recreation values of this area, the extent and locations of fuel treatments would likely be mitigated by the need to provide the scenic values expected by the recreating public. This could result in less effective fuels treatments compared to the other alternatives that emphasize the need for effective strategic treatments.

Consequences Specific to Alternative B

Alternative B replaces the distance-based Wildland-urban Intermix Defense and Threat Zones with strategic fire management zones. The majority of the critical habitat for Yosemite toad is located in the Wildfire Maintenance Zone and Wildfire Restoration Zone, which have desired conditions to be resilient to the range of fire effects and where wildland fire has predominantly positive benefits. Within these two strategic fire management zones, fires from lightning would be evaluated to determine if they could be managed with less than a full fire suppression response considering safety to firefighters and the public and potential positive and negative effects from expected fire behavior to various resources. To aid in determining the appropriate wildfire management strategy, spatial support tools are used to identify the locations of special habitats and key habitat areas, including critical habitat areas, so they can be considered. The direction will increase the likelihood that more wildfires will be managed in the future to restore the ecological role of fire and to improve ecosystem integrity and lessen future adverse effects of wildfires. Therefore, there would be a long-term improvement in Yosemite Toad habitat relative to alternative A.

Vegetation and fuels management could occur within the portion of critical habitat unit outside of wilderness near Lake Mary, especially within the community and general wildfire protection zones. Fuels treatments could use hand treatments, mechanical treatments, or prescribed burning or some combination of those methods. Within the riparian conservation areas surrounding occupied habitats, plan direction would limit the ground disturbing impacts to protect Yosemite toad habitat. Plan direction would also guide the design of treatments to meet the scenery needs of recreation in this heavily used area. Vegetation treatments that improve the resilience of the vegetation near occupied sites and fuels reduction treatments that lessen the risk of high severity wildfire outside the natural range of variation would benefit the Yosemite toad by providing more stability to the habitat conditions of occupied sites.

Consequences Specific to Alternative B-modified

Although the fire management zones are slightly different under alternatives B and B-modified, the effects to the toad from fire management would be the same. That is because within their habitat, the differences in fire management zones are so small that in effect, within Yosemite toad habitat, effects would not differ.

Consequences Specific to Alternative C

Although the strategic fire management zones in alternative C are different than those in the other alternatives, the effects to Yosemite toad are expected to be the same as B and B-modified. Most wildfires near Lake Mary would likely continue to be suppressed because of the risks to communities and assets.

In alternative C, there could be vegetation and fuels treatments planned in the Wildland-urban Intermix Defense Zone around Lake Mary, but the emphasis will be on hand treatments and the use of prescribed burning instead of on the use of mechanical equipment. There would likely be no difference in effect to Yosemite toads and there habitat, however, because mechanical treatments in Yosemite toad habitat would be designed to protect the species and its habitat. There could be slightly fewer short-term effects to habitat from mechanical treatment, but slightly greater potential negative effects from uncharacteristically large wildfires because alternative C would not be able to treat as many acres of fuels as alternatives B and B-modified.

Consequences Specific to Alternative D

The strategic fire management zones would be the same as alternative B-modified and the effects to Yosemite toad would be expected to be the same.

Since alternative D would have the highest amount of vegetation and fuels treatments of all alternative, there is a higher potential for fuels treatments to occur in or surrounding the community and general wildfire protection zones around Lake Mary than any of the other alternatives. To the extent this happens, it would reduce the risk of future wildfires burning with a higher severity than the natural range of variation which could affect the habitat used by Yosemite toads.

Lahontan Cutthroat Trout (Threatened)

Consequences Common to All Alternatives

All occupied habitat around O'Harrel Creek is fenced and excluded from domestic livestock grazing to protect the Lahontan cutthroat trout. Any future proposals to discontinue the fencing or to consider additional fencing would be guided by the plan direction to manage essential habitat for the species according to the recovery plan and to limit streambank disturbance.

Roads exist in the area of the lower portion of O'Harrel Creek; however, the fencing around all occupied portions of the creek limit impacts such as sedimentation from road associated uses. In all alternatives, road maintenance will implement best management practices and projects would be designed to avoid, minimize, or mitigate potential impacts to occupied habitat and would require consultation with the U.S. Fish and Wildlife Service if the projects may affect the species. Most of the roads exist downstream of the occupied habitat, which is in an inventoried roadless area, limiting the potential for road-related impacts.

Restoration activities, particularly the installation of instream structures to benefit Lahontan cutthroat trout have occurred in the past and could occur in the future, including installation of new structures or maintenance of existing structures. If in-stream activities are planned they could adversely affect Lahontan cutthroat trout in the short term but would be designed to improve ecological conditions in the long term. As stated in the existing conditions section, this population is out-of-basin and habitat suitability is marginal.

If additional restoration activities are needed, such as restoration if wildfires burn within the watershed, the Inyo National Forest would coordinate with California Department of Fish and Wildlife and U.S. Fish and Wildlife Service to insure protection of habitat. While this would occur under alternative A without specific plan direction, it is addressed as a plan goal in alternatives B, B-modified, C, and D to document the Inyo's intent to coordinate to improve conditions for federally listed species.

Consequences Specific to Alternative A

As described in the section on "Aquatic and Riparian Ecosystems," alternative A includes an aquatic and riparian conservation strategy focused on riparian conservation areas and critical aquatic refuges. The O'Harrel critical aquatic refuge was identified in 2001 to be managed for recovery of Lahontan cutthroat trout (USDA Forest Service 2001b). Projects proposed within the critical aquatic refuge would be guided by direction to provide habitat for Lahontan cutthroat trout and to restrict or minimize activities that would impact riparian habitats or stream conditions. As the occupied habitat is currently fenced and expected to be maintained through the life of the forest plan, no substantial consequences to Lahontan cutthroat trout habitat are anticipated.

O'Harrel Creek does not contain any Wildland-urban Intermix Defense or Threat Zones so there is no specific fire management direction; however, because of the general proximity to non-national forest lands near Benton Crossing and Lake Crowley, it is likely that most wildfires will have some fire suppression actions taken. The occupied portions of O'Harrel Creek are identified as terrestrial aerial retardant avoidance areas on maps used when suppressing wildfires (USDA Forest Service 2011c). This will reduce the risk of aerial retardants entering the occupied portions of O'Harrel Creek and affecting fish, but reduced use of retardants could also result in wildfires burning at higher intensities or across larger areas which could cause higher risks of post-fire sedimentation. Although sedimentation could occur that impacts the occupied stream segment given the generally sparse vegetation in this area, the risks of substantial high-severity fire effects would likely be low to moderate.

Consequences Specific to Alternative B, B-modified, C, and D

As described in the section on "Aquatic and Riparian Ecosystems," all plan revision alternatives include an aquatic and riparian conservation strategy that provides a comprehensive and multi-scale management framework for watershed, riparian and stream conservation. The aquatic and riparian conservation strategy is similar to alternative A retaining the essential elements of the existing management direction for riparian conservation areas. There are many specific desired conditions for watersheds forestwide and for riparian conservation areas that would shape the purpose and need and project design outcomes of future projects. Desired conditions for the riparian conservation areas and watersheds provide beneficial functions such as cold, clean water; stream shading; aquatic/riparian habitat; and nutrients. There are also many specific standards and guidelines that avoid, mitigate, or minimize certain types of activities or intensities or magnitudes of effects within riparian conservation areas and to riparian resources. These plan components collectively help assure stream and riparian habitats are conserved and restored for long-term sustainability and resilience of the ecological conditions that contribute to species recovery. The plan revision alternatives vary in management of critical aquatic refuges or conservation watersheds, which will be discussed for each alternative below.

For the Lahontan cutthroat trout, the entire segment of O'Harrel Canyon Creek (Stream ID 1.141) was evaluated and has been found to meet the eligibility requirements to be considered for inclusion in the National Wild and Scenic Rivers System. The assigned preliminary classification is "recreational river." Eligible wild and scenic rivers are managed by applying interim protection measures that protect them sufficiently to maintain free flow and outstandingly remarkable values. Fisheries, because of the presence of Lahontan cutthroat trout, are identified as one of the outstandingly remarkable values. Future in-stream habitat restoration projects, such as, construction of structures and vegetation management to protect and enhance wildlife and fish habitat, can occur within recreational rivers as long as they fully protect identified river values and do not affect the river's free-flowing character. Vegetation and fuels management projects would be evaluated for consistency with the eligible wild and scenic river status. Any planned vegetation or fuels management projects would likely be designed to be of low intensity in order to maintain the scenic characteristics of a recreational class wild and scenic river.

Additional plan direction further limits the potential for impacts to riparian resources when prescribed fires are planned. When water drafting is needed on projects, screening devices are required to minimize removal of aquatic species from aquatic habitats, including juvenile fish, amphibian egg masses and tadpoles. However, prior to determining if water drafting would be suitable for occupied habitats, the proposed sites would be evaluated for effects to Lahontan cutthroat trout and in some cases, water drafting may be prohibited. Efforts to manage the impacts of wildfires and to implement vegetation and fuels management to lessen the risk of habitat loss or the potential for sediment from adjacent burned areas from impacting occupied habitats would contribute towards recovery of this species by better protecting this out-of-basin population. The potential for proposing mechanical vegetation and fuels treatments is limited in the upper portions of O'Harrel Creek being within inventoried roadless areas where access is limited.

While the Inyo National Forest does not manage activities that occur on private lands, including the recreation that occurs on the private land parcel along O'Harrel Creek, these alternatives would include a goal to cooperate with partners and private landowners to encourage resource protection and restoration across ownership boundaries. An additional goal for sustainable recreation is to manage dispersed recreation activities when evidence of impacts to natural resources emerge or are causing damage. Together these goals would facilitate working with private landowners and managing recreation on the Inyo National Forest to minimize impacts to occupied habitats where possible.

Consequences Specific to Alternative B

The O'Harrel critical aquatic refuge would be managed the same as alternative A and would have the same consequences. The O'Harrel Creek area is predominately within the Wildfire Restoration Zone in the upper portions within the inventoried roadless area and General Wildfire Protection Zone in the lower portion. In the Wildfire Restoration Zone, when naturally caused wildfires occur, they will be evaluated to determine if they could be managed to restore fire to the landscape with acceptable effects to highly valued resources, such as the Lahontan cutthroat habitat. In the General Wildfire Protection Zone, many wildfires will likely continue to have some fire suppression actions taken because of the higher risk of threats to communities and highly valued resources and assets. This would be similar to alternative A where most wildfires would have some fire suppression actions taken. Fires would be managed whenever possible to reduce the potential future sediment inputs from large wildfires that burn outside the natural range of variation. There could be greater long-term reduction in sediment input to O'Harrel Creek, and therefore greater protection of Lahontan cutthroat trout habitat, with this reduction in large wildfires.

Consequences Specific to Alternative B-modified

With the forestwide direction for animal and plant species coupled with the multi-scale aquatic and riparian conservation strategy approach, alternative B-modified is functionally equivalent to alternatives A and B. Any proposed activities that would affect the area around the occupied portions of O'Harrel Creek would be guided by forestwide direction for at-risk species and watersheds. This provides desired conditions and guidance in project design to maintain, improve, or protect ecological conditions needed to contribute to the recovery of Lahontan cutthroat trout. The removal of the O'Harrel Creek critical aquatic refuge would likely cause no difference to the trout's habitat because protections would still exist under the riparian conservation area direction, Endangered Species Act, and general watershed protections.

The strategic fire zones in the area around O'Harrel Creek is very similar to alternative B. Because the differences are minor, the consequences are expected to be the same as those described for alternative B.

Consequences Specific to Alternative C

The O'Harrel critical aquatic refuge would be managed the same and have the same consequences as alternative A. Alternative C does not differentiate between the General Wildfire Protection Zone and Wildfire Restoration Zone like the other plan revision alternatives, instead categorizing the area around O'Harrel Creek as the general wildfire zone. Regardless, the direction for managing fire be the same as t the other plan revision alternatives by having guidance to manage wildfires to meet resources objectives when it is safe to do so and manage and mitigate the impacts of fire suppression activities to the extent possible. Thus, even though the mapped fire zones would be different between the alternatives in the area that could affect Lahontan cutthroat trout, the consequences would be similar to those described for alternative B, B-modified, and D because fire management decisions would be guided by protection of life and property and managing wildfires to meet resource objectives, which would restore fire as an ecological process, when it is safe to do so. Alternative C would limit mechanical treatments to restore vegetation or treat fuels, but since little vegetation treatment or fuels reduction is likely due to the inventoried roadless area and eligible wild and scenic river status, there would be little difference between the plan revision alternatives and the consequences would be similar to that described for alternatives B and B-modified. There could be a slightly higher chance of increased sediment input from large wildfires with less overall fuels treatment across the Forest, but in this watershed, the difference between alternatives would be very small because this is not an area where landscape scale fuels treatments are likely.

Consequences Specific to Alternative D

The O'Harrel critical aquatic refuge would be managed the same and have the same consequences as described for alternative A. The direction and consequences for managing fire would be the same as described for alternative B-modified.

Paiute Cutthroat Trout (Threatened)

Consequences Common to All Alternatives

All alternatives include an aquatic and riparian conservation strategy that provides a multi-scale management framework for watershed, riparian and stream conservation and management. This will provide for Paiute cutthroat trout habitat conservation to sustain their viability to the extent that activities occur within the occupied portions of Leidy Creek watershed (Cabin Creek population) and the Cottonwood Creek watershed (North Fork of Cottonwood Creek population). The aquatic and riparian conservation strategy in all alternatives retains the essential elements of the existing management direction for riparian conservation areas, which were designed to protect riparian and aquatic habitat. The plan revision alternatives vary in management of critical aquatic refuges or conservation watersheds, which will be discussed for each alternative below.

Since occupied habitat areas for both populations are located within the designated White Mountains Wilderness, there are expected to be no effects from vegetation management. The primary risk of habitat effects is related to wildfire impacts from suppression activities or from how fire is managed as an ecosystem function. Within wilderness, fire suppression activities would employ minimum impact suppression techniques wherever feasible in all alternatives. The occupied portions of Cabin Creek and North Fork of Cottonwood Creek are identified as terrestrial aerial retardant avoidance areas on maps used when suppressing wildfires (USDA Forest Service 2011c). Use of aerial retardants is minimized within designated wilderness areas unless needed to protect life or property. When needed, water drops from helicopters is preferred to minimize impacts to wilderness character and if needed near occupied habitat, to limit the risk of adverse fire effects to federally listed species. The effect of these actions would minimize the risks of direct impacts from fire suppression activities and fire-related sediment to occupied habitats.

In the area around the North Fork of Cottonwood Creek, the Cottonwood Creek and Tres Plumas Allotments are in non-use status which is allowing passive restoration of the riparian systems, contributing to a reduction in sediment and the improvement of habitat conditions for the Paiute cutthroat trout. In the future, if stream and riparian conditions improve, future livestock use of the allotments could be considered. Any proposals to authorize livestock grazing in these areas would be guided by plan direction that land management activities be designed to maintain or enhance self-sustaining populations of at-risk species within the inherent capabilities of the plan area by considering the relationship of threats (including site-specific threats) and activities to species survival and reproduction. The Cabin Creek area has not been grazed since 2005. However, if livestock grazing occurs there in the future, it would be managed by a grazing permit guided by a project-level biological opinion from the U.S. Fish and Wildlife Service. In both cases, livestock grazing would be mitigated by plan direction that limits streambank disturbance from livestock to 10 percent of the occupied or essential habitat stream reach identified in the Paiute cutthroat trout recovery plan. Livestock grazing management would not vary by alternative, and therefore these effects would be the same under all alternatives.

In order to avoid the risk of hybridization, it is important to maintain the existing barriers that isolate occupied habitats from downstream populations of rainbow trout. The plan revision alternatives include a desired condition that recognizes that while generally the desire for stream ecosystems is to exhibit full connectivity where feasible to maintain aquatic species diversity, in some cases barriers need to be maintained to protect native aquatic species. If a change were to occur to the barriers at these two sites that threaten their effectiveness, projects would be considered to meet the desired condition to manage for ecological conditions that contribute to the survival, recovery, and delisting of species under the Endangered Species Act and the goal to coordinate with the U.S. Fish and Wildlife Service and with California Department of Fish and Wildlife to restore and maintain essential habitat for at-risk species and implement other recovery actions consistent with species recovery plans. Maintaining a functional barrier would contribute towards the recovery plan by protecting and enhancing occupied Paiute cutthroat trout habitat.

Consequences Specific to Alternative A

As described in the section on "Aquatic and Riparian Ecosystems," alternative A includes an aquatic and riparian conservation strategy focused on riparian conservation areas and critical aquatic refuges. The Cottonwood Creek critical aquatic refuge was identified in 2001 to be managed for recovery of Paiute cutthroat trout (USDA Forest Service 2001b). Projects proposed within the critical aquatic refuge would be guided by direction to provide habitat for Paiute cutthroat trout and to restrict or minimize activities that would impact riparian habitats or stream conditions. The occupied habitat is located within the White Mountains Wilderness, no active vegetation or fuels activities are expected and therefore no effects to Paiute cutthroat trout habitat are anticipated.

Neither Cabin Creek nor the North Fork of Cottonwood Creek is near any Wildland-urban Intermix Defense or Threat Zones so there is no specific fire management direction. Since both locations are within the White Mountains Wilderness, it is likely that most wildfires will have limited fire suppression actions taken if they can be managed to meet resource objectives. The occupied portions of Cabin Creek and the North Fork of Cottonwood Creek are identified as terrestrial aerial retardant avoidance areas on maps used when suppressing wildfires (USDA Forest Service 2011c). This will reduce the risk of aerial retardants entering the occupied portions of these creeks and affecting fish, but reduced use of retardants could also result in wildfires burning at higher intensities or across larger areas which could cause higher risks of post-fire sedimentation. Sedimentation could occur that impacts the occupied stream segment given the generally sparse vegetation in this area though, the risks would likely be low to moderate of substantial high-severity fire effects.

Consequences Specific to Alternative B, B-modified, C, and D

The direction for watersheds and riparian conservation areas would build resilience into watershed systems and habitats to better enable them to adapt to drought and climate change and enable stream systems and associated habitats to adapt to altered flow regimes and disturbances.

For the Paiute cutthroat trout, an additional 1.66 miles of the North Fork of Cottonwood Creek (Stream ID 1.028) was evaluated and has been found to meet the eligibility requirements to be considered for inclusion in the National Wild and Scenic Rivers System. This additional section includes the headwaters of the North Fork of Cottonwood Creek above the occupied area. The assigned preliminary classification is "wild river." Eligible wild and scenic rivers are managed by applying interim protection measures that protect them sufficiently to maintain free flow and outstandingly remarkable values unless a determination of ineligibility or non-suitability is made. Fisheries, because of the presence of Paiute cutthroat trout, are identified as one of the outstandingly remarkable values. Future in-stream habitat restoration projects, such as, construction of structures and vegetation management to protect and enhance wildlife and fish habitat, can occur within wild rivers as long as they fully protect identified river values and do not affect the river's free-flowing character. Cutting of trees or vegetation in eligible wild and scenic rivers would not occur with a few exceptions, for example, maintaining trails or suppressing fires or to protect outstanding remarkable values. Prescribed burning projects are allowed if they are designed to maintain or restore at-risk species habitats or to restore the natural range of variability. Since the occupied habitat is within the White Mountains Wilderness, cutting of trees or prescribed burning is not expected to occur, except trees may be cut during fire suppression.

The plan revision alternatives include plan direction to improve the delivery of public information regarding management of natural resources and at-risk species management through conservation education which contributes to a recovery plan action.

The recovery plan calls for developing a long term conservation plan and conservation agreement for managing the Paiute cutthroat trout. For the two out-of-basin populations of Paiute cutthroat trout that occur on the Inyo National Forest, a goal describes the intent of the Inyo to work with the State and Federal wildlife agencies to restore and maintain essential habitat for at-risk species and implement other recovery actions consistent with species recovery plans. If conservation strategies are developed or a conservation agreement is approved, actions to implement conservation actions would be provided by plan direction that habitat management objectives or goals from approved conservation strategies or agreements should be incorporated, if appropriate, in the design of projects that will occur within at-risk species habitat. This would serve to ensure actions are contributing to the recovery of the species.

Consequences Specific to Alternative B

The Cottonwood Creek critical aquatic refuge would be managed the same as alternative A and would have the same consequences.

Since Cabin Creek is within the wildfire maintenance zone, when naturally caused wildfires occur, they will be evaluated to determine if they could be managed to restore fire to the landscape while having acceptable effects to highly valued resources, such as habitats for at-risk species. The occupied habitat in the North Fork of Cottonwood Creek is within the general wildfire protection zone due to its proximity to the Ancient Bristlecone Pine Forest. In this zone, many wildfires are expected to continue to have some fire suppression actions taken because of the higher risk of threats to highly valued resources and assets. As a result, it may be more difficult to restore fire as a landscape element than in alternatives A, B-modified, or C.

Consequences Specific to Alternative B-modified

This alternative does not identify Cottonwood Creek critical aquatic refuge as a management area for Paiute cutthroat trout. In this alternative, the area would instead be managed as part of the larger Cottonwood-Crooked Creek Headwaters Conservation Watershed. The desired condition for conservation watersheds emphasizes their importance for habitats for the recovery of federally listed species. Additionally, restoration projects and actions within Conservation Watersheds would be a high priority for implementation and monitoring. Since the occupied portion of Cottonwood Creek is within designated wilderness, it is not likely that active, ground-disturbing restoration would be proposed or would occur. Instead, passive restoration and non-ground-disturbing actions that improve Watershed Condition Framework indicators would be given priority.

This alternative includes forestwide direction for riparian conservation areas, upland areas, and animal and plant species which coupled with the conservation watershed, would provide the same or better protection to the Paiute cutthroat trout as that provided by the critical aquatic refuge under the other alternatives. The plan provides desired conditions and guidance in project design to maintain, improve, or protect ecological conditions needed to contribute to the recovery of Paiute cutthroat trout (see SPEC-PCTR-STD and RCA plan components)

The strategic approach to wildfire management identifies the Cabin Creek area and North Fork of Cottonwood Creek area as part of the wildfire maintenance zone. In the area around the North Fork of Cottonwood Creek fire risks to the Ancient Bristlecone Pine Forest were offset by the benefits of restoring fire to the landscape and most fires were not likely to pose such a threat that suppression actions were likely to be the predominate action needed. In the wildfire maintenance zone, the desired condition is that ecosystems are resilient to the impacts of wildfire and wildland fire has predominantly positive benefits to ecosystems and resources. Within this zone, when natural ignitions occur, efforts would be made to manage wildfires to meet resource objectives and restore and maintain fire as an ecological process. To the extent that fire can be restored to the landscape, this would benefit Paiute cutthroat trout by reducing the overall risk of fires burning outside of the natural range of variation which would lessen the risk of post-fire sediment impacts.

Consequences Specific to Alternative C

The Cottonwood Creek critical aquatic refuge would be managed the same and have the same consequences as alternative A. Alternative C would manage both the Cabin Creek occupied habitat and the North Fork of Cottonwood Creek occupied habitat as the wildlife maintenance zone as described for alternative B-modified and would be expected to have the same consequences.

Consequences Specific to Alternative D

The Cottonwood Creek critical aquatic refuge would be managed the same and have the same consequences as alternative A. Alternative D would use the same strategic wildfire zones as alternative B-modified and would have the same consequences.

Owens Tui Chub (Endangered)

Consequences Common to All Alternatives

All alternatives include an aquatic and riparian conservation strategy that provides a comprehensive and multi-scale management framework for watershed, riparian and stream conservation and management in the plan area, which will indirectly provide for Owens tui chub habitat conservation to sustain their viability to the extent that activities occur within the occupied portions of the Hot Creek watershed and in the upper portion of the Middle Fork of the San Joaquin River watershed near Sotcher Lake.

The aquatic and riparian conservation strategy in the plan revision alternatives retains the essential elements of the existing management direction for riparian conservation areas, a variable distance buffer area surrounding streams and bodies of water. Desired conditions for the riparian conservation areas provide ecologically appropriate and resilient riparian vegetation and functioning aquatic systems. There are specific standards and guidelines that would avoid, mitigate, or minimize certain types of activities or intensities or magnitudes of effects within riparian conservation areas and to riparian resources. Although many of the specific plan components change in wording or plan component or plan content type between alternative A and the plan revision alternatives, the functional intent is retained overall in the forest plan or by other applicable laws, regulations, or policies of the agency. These plan components collectively help assure stream and riparian habitats are conserved and restored for long-term sustainability and resilience, and contribute to species long-term viability.

While the Forest Service regulates surface activities on National Forest System lands, regulating water rights and water withdrawals is under the authority of the State of California and is outside the authority of the Forest Service. Water withdrawal affecting Little Hot Creek Pond is not expected because the majority of the headwaters area affecting the pond is National Forest System lands and there are no known or expected withdrawal proposals on the national forest. Water withdrawals or changes from activities that might affect the seeps and springs that feed the hydrology of the ponds are unlikely given direction in desired conditions that water developments that might dewater aquatic habitat for at-risk species should be avoided. In additions, desired conditions describe adequate quantity and timing of water flows to support aquatic species and that there are sufficient in-stream flows to support aquatic biota. There is concern about impacts to water at the Little Hot Creek Pond from the Casa Diablo IV geothermal energy development projects located in the Mammoth Lakes area. Effects to springs from the Casa Diablo project are monitored by the US Geological Survey, and no effects have been found over decades of monitoring. Effects will continue to monitored and if any effects are found, management changes will be made in conjunction with U.S. Fish and Wildlife Service direction, and the BLM, which has jurisdiction over geothermal development.

The Little Hot Creek Pond may be buffered slightly from environmental stochasticity related to drought and annual weather variability because of the spring fed nature of the hydrologic system that feeds it. The dry grassland and shrublands that surround this area reduce the magnitude and risk of substantial impacts from wildfire, if it were to occur. The effects of climate change may be expressed in many ways, such as changes in precipitation patterns and runoff patterns that could affect streamflows and groundwater systems that feed the springs and seeps that supply the Little Hot Creek Pond. Changes in water withdrawals that feed the ponds are not expected during the life of the forest plan and projects would be designed to consider watershed resilience to climate change and if projects proposed changes in instream flows, they would consider the effects on Little Hot Creek Pond.

Demographic and genetic stochasticity are outside the authority of the Forest Service to directly address other than the Inyo would cooperate and coordinate with the U.S. Fish and Wildlife Service or California Department of Fish and Wildlife if recovery actions to augment or establish additional populations were determined to be necessary to contribute to the recovery of the Owens tui chub.

The management of livestock grazing is not expected to affect this species because the areas around the Little Hot Creek Ponds are fenced and not subject to livestock grazing and no livestock grazing occurs around Sotcher Lake. Following a project level consultation with the U.S. Fish and Wildlife Service, the Little Hot Creek Pond is currently fenced to exclude livestock and to discourage other uses. It is expected that this fence will be maintained through the life of the forest plan to avoid impacts to Owens tui chub habitat from domestic livestock grazing and incidental public uses, including recreation uses.

Roads are not expected to affect this species because the road adjacent to the Little Hot Creek Pond is maintained as a gravel road to minimize dust and erosion risks to the pond and routine maintenance along this section is not expected to impact the pond. There are no roads immediately adjacent to Sotcher Lake. The main access road to Reds Meadow has a small parking area near the road for the Sotcher Lake Picnic area but continued use and management of the road and picnic area infrastructure would not affect Sotcher Lake.

All alternatives recognize that it is desirable for some barriers to be maintained in good condition to protect native aquatic species. As described above, the Little Hot Creek Pond is currently isolated from nonnative aquatic predators like largemouth bass and brown trout and hybridization with Lahontan tui chub by downstream diversions that prevent connection with the Owens River. It is not anticipated that bass or trout will become introduced or established in the Little Hot Creek Pond because it does not provide suitable habitat and is small in size. If a change were to occur to these barriers to threaten their effectiveness, projects would be considered to avoid hybridization in order to contribute to the survival, recovery, and delisting of species under the Endangered Species Act. This would contribute to recovery of the species by using barriers to separate occupied habitat from deleterious nonnative species.

The area around Little Hot Creek Pond was evaluated along with the California Department of Fish and Wildlife for management options for the emergent vegetation growing within the pond. While there is some vegetation encroachment, the population of Owens tui chub appears to be stable. The Inyo would continue to coordinate with the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife to evaluate habitat conditions at Little Hot Creek Pond under all alternatives. If it’s determined that vegetation control is needed and the specific equipment needed is available, the Inyo would develop a site-specific project with sufficient design features and mitigations to contribute to recovery of the species.

Although mosquitofish are abundant at Little Hot Creek Pond, the tui chub population at Little Hot Creek Pond appears to continue to reproduce and thrive in the presence of mosquitofish in this location. At this time, control of mosquitofish is not planned, but the Inyo would consider action, if feasible, if recommended by the U.S. Fish and Wildlife Service or California Department of Fish and Wildlife in order to contribute to the recovery of the Owens tui chub.

Consequences Specific to Alternative A

The current forest plan does not include species-specific plan direction for Owens tui chub so relevant direction is primarily found in direction for riparian conservation areas and critical aquatic refuges. The direction for riparian conservation areas would provide project direction to limit activities that would adversely affect riparian vegetation and protect habitat conditions for Owens tui chub in Little Hot Creek Pond. When projects are proposed within the Little Hot Creek critical aquatic refuge, they would be designed to contribute to the recovery of the Owens tui chub. Since the area surrounding the pond is already fenced to eliminate livestock grazing and to reduce other incidental public uses, no additional protective actions are expected to occur over the life of the forest plan.

Because of the existing sparse vegetation conditions around Little Hot Creek, no fuels management is likely to be needed or occur during the life of the forest plan and the risk of adverse effects from fire suppression or potential post-fire erosion impacts is low. The area around Sotcher Lake is within the Wildland-urban Intermix Threat Zone where fuels reduction projects could be planned to reduce the levels of fuels that could lead to larger or higher severity wildfires that could threaten the Wildland-urban Intermix Defense Zone around Reds Meadow or the nearby communities around Mammoth Lake. If fuels management projects are proposed, they would be guided by direction for riparian conservation areas to have the ecological conditions that contribute to the recovery of threatened and endangered species. Fuels management activities would typically occur in the upland areas and not immediately affect the lakeshore or riparian habitats that might affect habitat conditions for the Owens tui chub.

It is unknown if there are any habitat restoration needs for Sotcher Lake to benefit Owens tui chub. While recreation occurs around Sotcher Lake, it is unknown if activities on the shoreline are affecting the aquatic habitats used by this species; however, if shoreline impacts are causing impacts they could be mitigated by direction for riparian conservation areas to limit shoreline disturbance.

Consequences Common to Alternatives B, B-modified, C, and D

For the Owens tui chub, the entire segment of Little Hot Creek (Stream ID 1.084) was evaluated and found to meet the eligibility requirements to be considered for inclusion in the National Wild and Scenic Rivers System. The assigned preliminary classification is “recreational river.” Any future proposed projects would be guided by direction that applies interim protection measures to ensure they are protected sufficiently to maintain free flow and outstandingly remarkable values. Future in-stream habitat restoration projects, such as, construction of structures and vegetation management to protect and enhance wildlife and fish habitat, can occur within recreational rivers as long as they fully protect identified river values and do not affect the river’s free-flowing character.

The forestwide direction for watersheds and direction for riparian conservation areas would build resilience into watershed systems and habitats by guiding projects to better enable watersheds to adapt to drought and climate change and enable stream systems and associated habitats to adapt to altered flow regimes and disturbances.

There is a risk of fire effects for the Sotcher Lake population because it is in a forested environment where fire risks are generally high. The area around Sotcher Lake is in the Community Wildfire Protection Zone where a high priority is on protecting assets from wildfire impacts and where, due to risks, most wildfires are expected to be fully suppressed under all alternatives. In order to reduce the risk of negative wildfire impacts, projects could be proposed around Sotcher Lake to meet a forest plan goal for the Community Wildfire Protection Zone to reduce the impacts of wildfire by creating fire-adapted communities through fuel reduction treatments, prescribed fire, and managing wildfires that can benefit natural resources while reducing risk. If fuels management projects are proposed, they would be guided by direction for riparian conservation areas to have the ecological conditions that contribute to the recovery of threatened and endangered species. Fuels management activities would typically occur in the upland areas and not immediately affect the lakeshore or riparian habitats that might provide direct habitat for the Owens tui chub. These projects would also be guided by a forestwide direction for watersheds to use best management practices to mitigate adverse impacts to soil and water resources.

Recreation around Sotcher Lake would be continue to be managed and the consequences would be similar to alternative A. In alternatives B and D there is an emphasis on providing sustainable recreation which would emphasize addressing and mitigating impacts from recreation to at-risk species; however, as described for alternative A, there are no known conflicts.

Consequences Specific to Alternative B-modified

The Little Hot Creek critical aquatic refuge would no longer be designated under Alternative B-modified. The forestwide direction for riparian conservation areas requires protection of aquatic and riparian species habitat, as well as the focus on protecting watershed function, will protect tui chub and their habitat by preventing major disturbances and attempting to improve resilience to climate change and other stochastic events. As a result, there are no substantial changes expected from the change in management approach that eliminates the Little Hot Creek critical aquatic refuge.

Sotcher Lake is within the Mammoth Lakes Destination Recreation Area where desired conditions provide for higher levels of development to manage the concentrated recreation uses within a natural appearing landscape. This lake is a popular location for fishing and there is a designated picnic area that receives heavy use. Given that information about the specific habitats and areas of occupancy in Sotcher Lake is not known, it is difficult to assess the potential for impacts from recreation uses. Within Destination Recreation Management Areas, direction to limit streambank and shoreline disturbance for riparian conservation areas may not currently be met in all cases, but projects would be designed and managed to reduce the percent of impact to the extent feasible. These activities are found to affect Owens tui chub, then consultation with the U.S. Fish and Wildlife Service would occur at the project-level. As explained for alternative A, there are no known restoration needs at Sotcher Lake and there would continue to be no known impacts from recreation.

The effects of vegetation management on this species is expected to be the same as described for alternative B. It is expected that fuels management would be planned within this area during the life of the forest plan. Direction for fuels management around Sotcher Lake would be guided by the same direction for riparian conservation areas as alternative B.

Fire management can affect Owens tui chub and its habitat primarily in terms of fire suppression impacts and potential post-fire erosion impacts. The low risk would be the same as described for alternative A for the Little Hot Creek Ponds population because of the sparse vegetation surrounding this area. The risk is higher for the Sotcher Lake population because it is in a forested environment where fire risks are higher and would be the same as described for alternative B since it would have the same Community Wildfire Protection Zone where most wildfires are expected to be fully suppressed.

Consequences Specific to Alternative C

Alternative C would continue to manage the Little Hot Creek critical aquatic refuge the same as alternatives B and D and would have the same consequences. Alternative C would manage the area around Sotcher Lake as part of the General Wildfire Zone. Since it is in close proximity to an area identified as Wildland-urban Intermix Defense Zone around Reds Meadow, it is expected that wildfires would be managed similarly to the other alternatives, likely with full suppression. There may be less vegetation treatment under alternative C due to the emphasis on prescribed fire instead of mechanical treatment. Because prescribed fire would be difficult to implement on a large scale in this highly used, dense forest area without previous mechanical thinning, there could be a greater potential for large wildfires that may increase sediment input into Sotcher Lake and affect tui chub habitat.

Recreation around Sotcher Lake would be managed the same as alternative A. There would not be specific direction for the area but if recreation impacts along the shoreline were occurring to Owens tui chub habitat, direction for riparian conservation areas would guide developing future site-specific actions to mitigate the impact.

Amphibians: (Black Toad, Inyo Mountains Slender Salamander, Kern Plateau Salamander)

These three species have been grouped here based on riparian ecosystems they depend on and the similarities in the consequences from the alternatives. The Inyo Mountains slender salamander occurs exclusively in isolated springs in largely desert ecosystems comprised of desert scrub. The Kern Plateau salamander occurs in perennially wet and moist habitat, usually in rocky outcrops or rock substrate. On the national forest, these conditions can be found largely on the Kern Plateau. Black toad is an aquatic species restricted to wet areas near permanent springs with subpopulations separated by arid desert scrub at least 1.5 km apart. Short plant cover which provides shaded/cooler environments and unobstructed access to still or slowly flowing water, rodent burrows in winter and shallow marsh and pond waters for breeding are all important habitat elements.

The black toad and Inyo Mountains slender salamander are Pacific Southwest Region sensitive species. Projects that may impact these species would complete a biological evaluation and ensure the continued viability of the species on Inyo National Forest. The Kern Plateau salamander is not identified as a sensitive species.

Alternatives B, B-modified, C, and D propose all three species as species of conservation concern (see chapter 2 under “Features Common to Alternatives B, B-modified, C, and D, Species of Conservation Concern.”) By doing so, forestwide watershed and forestwide at-risk species direction will be strengthened.

Under current plan direction (alternative A), there are no critical aquatic refuges designated for black toad. However, existing critical aquatic refuges do exist that benefit the Inyo Mountains slender salamander (Lead Canyon and Barrel Springs critical aquatic refuges) and Kern Plateau salamander (Olancha and Haiwee critical aquatic refuges). For both species of salamanders, the same critical aquatic refuges proposed under alternative A are proposed under alternatives B, C, and D. Birch Creek Critical Aquatic Refuge is proposed under alternatives B, C, and D that will benefit black toad. Alternative B-modified does not propose critical aquatic refuges, but proposes conservation watersheds instead. None of the three species occur within any of the proposed conservation watersheds under B-modified. Where additional critical aquatic refuges are proposed, such designation will strengthen forestwide direction in comparison to alternative A. Direction to protect species of conservation concern, as well as riparian conservation area direction, will be included in alternative B-modified, and will apply to riparian areas occupied by these species. The effects therefore will not change with the elimination of critical aquatic refuges.

Proposed recommended wilderness under alternatives B, B-modified, and C will result in Haiwee (alternatives B and B-modified) and portions of Olancha (alternative C) critical aquatic refuges being incorporated into the wilderness areas. Both the Lead Canyon and Barrel Springs critical aquatic refuges (Inyo Mountains slender salamander) are located within current wilderness areas. Alternative D proposes no recommended wilderness areas. Proposed recommended wilderness areas (Deep Springs North) under alternative C could limit restoration activities to non-mechanical methods. Nevertheless, threats to these species are primarily outside the control and authority of the Forest Service.

The black toad is an endemic species, limited to several isolated populations in Deep Springs Valley in Inyo County within close proximity to and or on the Inyo National Forest. Individuals have been documented on the Inyo, but the majority of the habitat and population is located on adjacent, private land. The Inyo National Forest will continue to provide additional (ephemeral) fringe habitat for dispersing adults. While the ecological conditions the black toad depends on appear generally stable and or trending in a positive direction based on current management, there is still substantial concern for the species persistence by simple virtue of its rarity and uncertain climate change related effects. As a result of this rarity and its limited distribution, this species is highly susceptible to stochastic events (such as flash floods) and drying conditions resulting from increasing temperatures and precipitation events. Its limited dispersal ability and isolated populations put it at further risk for localized extinctions and susceptibility to disease outbreaks. The preferred alternative includes ecosystem plan components and species specific plan components to maintain the necessary ecological conditions for a viable population of black toad on the Inyo. The Inyo's ability to maintain a viable population is limited, however, because the species primary range occurs outside of the national forest boundary and primary threats to the species are not within Forest Service control. Appendix F in volume 2 includes a more detailed discussion of black toad persistence.

Although the Kern Plateau salamander is largely restricted to the Kern Plateau and western portions of Owens Valley, it appears to be well distributed throughout its range. Most populations are not imperiled by ongoing threats or known to be declining. However, habitat on the Inyo National Forest may be naturally limited and increased wildland fire events coupled with subsequent flash floods that scour habitat are potential risk factors. Springs are sensitive water features due to their relative rarity, their small area, and their ecological importance relative to their size. Any activities that disrupt water flow puts spring ecosystems at risk. In addition, persistence of the salamander populations may be closely tied to climate variations that affect their habitat, especially if they experience extreme drying trends, or stochastic events such as flash floods. Given its endemism, restricted range and susceptibility to these environmental events, there is substantial concern for this species ability to persist on the planning unit. The Inyo National Forest has a number of ecosystem-level and species-specific plan components in place to mitigate risks within its management authority, but cannot mitigate all threats for persistence. Based upon this evaluation, the final set of ecosystem plan components and the additional species-specific plan components would provide the necessary ecological conditions to maintain a viable population of Kern Plateau Salamander within its range. However, key risk factors including climate change, ground water pumping and water diversions that occur off forest that are not within Forest Service control could affect spring habitat making it difficult to maintain viability in the plan area.

The Inyo Mountains slender salamander is an endemic species, limited to several isolated populations scattered throughout a small portion of the Inyo National Forest. While the ecological conditions the salamander depends on appear generally stable and or trending in a positive direction based on current management, there is still substantial concern for the species persistence by simple virtue of its rarity and uncertainty regarding climate change-related effects and losses in spring habitat. As a result of this rarity and its limited distribution, this species is highly susceptible to stochastic events such as flash floods, and drying conditions which may become more frequent with climate change. The Inyo Mountains slender salamander's limited dispersal ability and isolated populations put it at further risk for localized extinctions from these types of events. Further, the watershed is not wholly contained within the national forest and the Inyo has little control over water management outside national forest boundaries. For this reason, it will be difficult for the Inyo to fully restore this habitat to reference conditions.

Species viability of Inyo Mountains slender salamander on the Inyo is currently uncertain; however, proposed plan components are designed to move habitat conditions to a more desired ecological state than what currently exists. The Inyo National Forest has a number of ecosystem-level and species-specific plan components in place to mitigate risks within its management authority, but cannot mitigate all threats for persistence. Based upon this evaluation, the final set of ecosystem plan components and the additional species-specific plan components would provide the necessary ecological conditions to maintain a viable population of Inyo Mountains slender salamander within its range. However, key risk factors including climate change, ground water pumping and water diversions that occur off the national forest and are not within Forest Service management authority will continue to impact spring habitat making it difficult to maintain viability in the plan area.

California Golden Trout

Effects to California golden trout should vary only slightly between alternatives, because multiple layers of existing protections already apply to this species. Most of its habitat is within designated wilderness, where few ground-disturbing activities take place. Potential threats are all addressed by the Conservation Assessment and Strategy for the California Golden Trout (Stephens, McGuire, and Sims 2004), which will continue to be followed under all alternatives. Additionally, a Comprehensive Management Plan for the North Fork and South Forks of the Kern Wild and Scenic River (USDA Forest Service 1994) provides overall management direction for the wild and scenic river. The wild and scenic river designation for the North and South Forks of the Kern River would continue under all alternatives.

Under alternatives B, B-modified, C, and D, Golden Trout Creek is proposed as an eligible wild and scenic river. The Inyo National Forest would therefore be required to maintain free flowing condition and the values that make it eligible as a wild and scenic river. This would provide another layer of protection for California golden trout, as it would prevent activities that would cause major changes to the stream.

Alternative A would continue to provide direction (for riparian habitat and sensitive species) through its forest plan components to guide management for the continued conservation of the California golden trout. California golden trout is a Pacific Southwest Region sensitive species. Any projects that may impact this species would be required to complete a biological evaluation and ensure the continued viability of the species on the national forest. Alternatives A, B, C, and D would continue providing direction for this species within the Golden Trout/Volcano Creeks critical aquatic refuge. Under B-modified, the South Fork of the Kern River and its headwaters would be designated a conservation watershed. This change would likely make little difference to habitat conditions, viability and persistence of this species. The designation of the conservation watershed may slightly improve habitat compared to existing conditions, because it would focus restoration activities on improving the entire watershed function. This could drive watershed improvements that could help improve resilience to climate change, fire, or other stochastic events. However, the difference is likely to be very slight, because most of the California golden trout habitat is within wilderness, and other than varying wildfire management strategies, there would be little difference in management of wilderness areas by alternative.

Alternatives B, B-modified, C, and D propose golden trout as a species of conservation concern. This designation will ensure that the Inyo implements management actions to improve persistence of the species. This is unlikely to, by itself, lead to any change in effects to the California golden trout, because the Inyo is already managing it under a conservation assessment and strategy.

Livestock grazing overlaps with golden trout habitat, and would continue under the same management direction under all alternatives. Grazing has been reduced over time, and many legacy impacts to streams within the Kern Plateau have improved and continue to improve. Under all alternatives, it would be expected that effects from grazing on stream habitat would continue to improve under plan direction, and would not vary by alternative.

The plan revision alternatives all have an emphasis on managing wildfire to return to a more natural fire regime and reduce the size and severity of wildfire. In golden trout habitat, the plan revision alternatives may therefore reduce negative effects from large fires relative to alternative A.

Aquatic Invertebrates (Owens Valley Springsnail, Western Pearlshell, Wong's Springsnail)

These species have been grouped due to their dependence on aquatic and/or riparian habitat and ecological similarities as aquatic invertebrates. Both species of springsnails are identified on the Pacific Southwest Region sensitive species list. Biological evaluations are required for proposed projects that may impact sensitive species and would continue under alternative A. The current forest plan provides standards and guidelines that generally limit disturbance and impacts within riparian conservation areas and critical aquatic refuges and call for consideration of impacts to aquatic and riparian systems and resources. The western pearlshell is currently not a Pacific Southwest Region sensitive species, and under alternative A, it would not be specifically considered in project planning.

All three species are proposed species of conservation concern in the plan revision alternatives (see chapter 2, under "Features Common to Alternatives B, B-modified, C, and D, Species of Conservation Concern"). This designation will ensure that the Inyo implements management actions to improve persistence of the species. Since western pearlshell would have no special status under alternative A, this designation could improve habitat for this species better under the plan revision alternatives. It would be specifically analyzed and management actions would specifically consider effects to this species.

Alternatives B, B-modified, and D would provide management more options and flexibility than alternatives A and C for restoring watersheds and habitat using fire (prescribed fire and managing fire for resource benefit) through the designation of four strategic fire management zones. In addition, more flexibility is provided to management for managing and restoring habitat within riparian systems using fire, and hand and mechanical treatments. More flexible management options and larger proposed acreage for treatment will be beneficial to these species if the restoration either directly or indirectly improves or restores habitat for these species found in riparian and aquatic systems. For example, if the headwaters of a river or creek are treated to reduce the density of trees and minimize the risks of a catastrophic wildfire in the future, the potential and amount of sedimentation into the aquatic system down below would be reduced. Aquatic species would be expected to benefit from improved water quality and substrate such as cobbles and stones in the water important for these aquatic invertebrates. However, for these three species, their habitat is not in areas that are likely to have much active vegetation management. They are more likely to benefit from fire management allowing a return to more natural fire intervals.

Alternative C would allow prescribed fire in riparian areas where it was historically prevalent to restore desired fuel conditions, to the extent it could occur with limited or no mechanical preparation. For these species, the effects would not be different than under the other plan revision alternatives because their habitat is not in areas where mechanical preparation is likely to occur, due to topography, vegetation types, and remote locations of many of the populations.

Under alternative B-modified, a total of three recreation management zones would be designated as a means to manage recreation and support sustainable use. The risks to these species are not originating from recreation activity so there would be no effects from these designations.

Livestock grazing will not vary by alternative; therefore effects will remain the same as under the existing condition.

Alternative C contains the southernmost population of pearlshell within recommended wilderness. Although recommended wilderness areas are proposed under alternatives B, B-modified, and C (not D), the benefits to these species is contingent on whether habitat exist for these species (or whether species they are present), condition and self-sustainability of the habitat over time, and limited management options for treating or restoring habitat, if needed, due to restrictions.

The Inyo National Forest has a number of ecosystem level and species specific plan components in place to mitigate risks within its management authority, but cannot mitigate all threats for persistence. Based upon this evaluation, the final set of ecosystem plan components and the additional species-specific plan components, when carried out, would provide the necessary ecological conditions to maintain a viable population of Western Pearlshell, Owen's Valley springsnail, and Wong's springsnail within its range.

Due to uncertainty about the species current viability, the potential for host species loss, general population loss or collapse, the limited amount of habitat on the Inyo National Forest, and potential future threats associated with climate change and ground water use, the Inyo's ability to maintain a viable population is limited.

Cumulative Effects

The analysis area is part of the greater southern Sierra Nevada ecosystem and is the vast majority of lands are administered or owned by the several Federal agencies, the State of California, water and power utilities, several Native American Tribes, and private landowners. The present and foreseeable actions of these public land management agencies and private landowners will determine the cumulative consequences to aquatic habitat conditions.

The majority of the land within the analysis area that is managed by Federal land management agencies have individual resource management plans or shared, collaborative programs in place to guide the protection of natural resources, particularly in the management of wildfires. The focus of the 2012 Planning Rule on ecosystem integrity, resilience, and diversity is in close alignment with new direction for the National Park Service, which is to build ecosystem resilience for coping with changing climates. The "Strategic Framework for Science in Support of Management in the South Sierra Nevada Ecoregion" was developed collaboratively by Federal land managers in the Southern Sierra Nevada ecoregion (including the Sierra and Sequoia National Forests and Giant Sequoia National Monument) to help mitigate impacts from, and adapt to, climate change (Nydick and Sydoriak 2011a, b). Cumulatively, the strategic collaborations developed by the federal agencies, combined with plan components and the plan's similar focus on increasing landscape resilience, should improve region-wide habitat for at-risk aquatic species. Land management activities across jurisdictions containing the same at-risk species, should be complementary and work together to improve viability and persistence of species.

The Forest Service will continue to work with the States in developing total maximum daily load strategic action plans for the 303(d) listed streams. If sources of impairment are identified related to Forest Service management, the total maximum daily loads plans may identify mitigation strategies including implementation of best management practices, maintenance or decommissioning of facilities, roads, and trails, implementation of currently planned restoration projects, and removal of existing stressors. The operators of the various dams associated with rivers in the analysis area adapt their operations to meet Federal Energy Regulatory Commission relicensing requirements and to address effects of climate change on runoff and baseflows. All alternatives minimize the effects of stream diversions or other flow modifications on at-risk species for Federal Energy Regulatory Commission, State and other authorized water use planning, water rights, and relicensing on the national forest. The Federal Energy Regulatory Commission and the power companies in conjunction with the Forest Service will continue working collaboratively to address issues as they arise in the future. These collaborations will help maximize improvement to at-risk species habitat, within the constraints of existing infrastructure.

The proposed management approaches under each of the plan revision alternatives are generally consistent with management of other public lands within the cumulative effects analysis area. Although the alternatives vary in their ability and pace to achieve the desired conditions and some alternatives present more risk of short-term impacts to aquatic habitats than others, it is not expected that the management approach under any alternative would have an adverse cumulative effect on aquatic habitats on other lands within the analysis area. Therefore, given that the majority of the land in the analysis area is managed by Federal agencies and guided by individual resource management plans as well as stronger, more relevant multi-agency partnerships, these strong consistencies in management direction are expected to provide for landscape-level resilience.

Analytical Conclusions

The alternatives considered in detail outline different approaches to achieving the same overall set of goals for maintaining and enhancing aquatic habitats and watershed health. This section summarizes how well these alternatives are expected to achieve these goals expressed in terms of the quality and quantity of aquatic habitats as they relate to effects to aquatic at-risk species.

For most species, plan components describe broad desired conditions that would provide for the ecosystem fabric to support a sufficient distribution of individuals of species of conservation concern and their habitat so that species are resilient to stressors and are likely to persist into the future. Species distribution is partially provided for by the fact that plan components aim to maintain or restore the diversity and connectivity of ecosystems and habitat types throughout the plan area. Fine-filter (special habitat-specific) plan components complement that direction by maintaining individuals of species that rely on smaller scale habitats or have very limited distribution. Finally, when necessary, project-level protections are an option. As a result, each threat in each ecosystem for each species of conservation concern identified has been addressed or mitigated in at least one plan component in each alternative, so that the persistence of each species is provided for.

If, during the life of a plan, it is found that plan components are not sufficient to ensure the persistence of species of conservation concern, the monitoring program developed for the plan should detect this and changes to the plan components would be considered to address the issue.

Federally Listed Endangered and Threatened Aquatic Species Determinations

The forest plan provides a programmatic framework for future site-specific projects and actions but does not prescribe specific projects or assign project locations. Plan components exist to ensure proposed actions avoid, mitigate or minimize impacts to threatened and endangered species. All future project-level activities that may affect federally listed species will require project-specific assessments and consultation under section 7 of the Endangered Species Act.

For aquatic threatened and endangered species, the biological assessment determined that plan components and plan content that would serve to avoid, mitigate, or minimize effects to federally listed species, yet actions and activities may disturb and displace individuals and habitat could be affected by restoration activities. Since the forest plan is at a programmatic level, it cannot ensure that projects developed under it would have no effect or that all actions would be discountable, insignificant or beneficial to federally listed species. Therefore, the biological assessment determined that adoption of the revised forest plan under all alternatives *may affect and is likely to adversely affect* the northern distinct population segment of the mountain yellow-legged frog, Sierra Nevada yellow-legged frog, Yosemite toad, Lahontan cutthroat trout, Paiute cutthroat trout, and Owens tui chub. We believe that because of the conservation measures of the alternatives, the U.S. Fish and Wildlife Service will determine that adopting any of the alternatives would not jeopardize the continued existence of these species when they issue a biological opinion.

Critical habitat on the Inyo National Forest has been designated for the northern distinct population segment of the mountain yellow-legged frog, Sierra Nevada yellow-legged frog, and the Yosemite toad. For the purpose of consultation under the Endangered Species Act, we determined that although all alternatives are designed to conserve critical habitat, because some restoration actions, such as meadow or stream restoration may have short-term adverse effects to critical habitat, adoption of the revised forest plan under all alternatives *may affect and is likely to adversely affect critical habitat* for these species. Due to the conservation approach of the alternatives, we believe that the U.S. Fish and Wildlife Service will determine that at the programmatic level, all of the alternatives are not likely to result in destruction or adverse modification of critical habitat.

For the purpose of revising the forest plan, we determined that all plan revision alternatives have developed adequate plan components (ecosystem and species-specific) to provide for ecological conditions that contribute to the recovery of aquatic federally-listed species within the plan area.

Aquatic Species of Conservation Concern Outcomes

This determination is summarized from the persistence analysis in appendix F of this document. The persistence analysis found that for all six aquatic species of conservation concern, "it is beyond the authority of the Forest Service to maintain or restore the ecological conditions to maintain a viable population of the species in the plan area. Nonetheless, the plan components should maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range." The persistence analysis based these conclusions on the plan components ability to protect water flows, manage invasive species, improve ecosystem resilience to climate change and other events outside the control of the Forest Service, and collaborate with other agencies and organizations to restore and maintain at-risk species and their habitat.

At-risk Plant Species

Background

Similar to other at-risk species sections, we evaluate and disclose the potential environmental consequences of the forest plan alternatives on at-risk plant species and habitat; evaluating the effectiveness of the alternatives to provide direction to create the ecological conditions to conserve candidate species and maintain a viable population of species of conservation concern within the plan area. As previously discussed, the need for plan revisions is guided by three primary topics, including ecological integrity which addresses the need to restore the resilience of vegetation and aquatic and riparian ecosystems to fire, drought, and climate impacts; restore plant habitat and diversity; and reduce the risk of wildfire impacts to species habitat. The alternatives present a range of approaches that address the revision topics and issues, including the issues related to at-risk plant species and habitat.

The sections on "Terrestrial Ecosystems" and "Aquatic and Riparian Ecosystems" cover the ecological integrity of the ecosystems upon which at-risk plant species depend and evaluate the consequences of implementing the alternatives on various taxa[35] by integrating an analysis of wildlife, aquatic, invertebrate, and plant species. In this section, the evaluation was completed by examining conditions of and threats to individual at-risk plant species, and also by examining the collective distribution patterns of at-risk flora within the plan area, by biogeographic region and by ecosystem. This approach assists in understanding the broad relationship between a programmatic land management plan and the desired conditions identified for at-risk species.

Analysis and Methods

The analysis area includes all National Forest System lands within the Inyo National Forest. In some cases, the best available scientific information for at-risk species' ecological relationships originated outside the analysis area. However, we used indicator measures and threat information from within the analysis area in making conclusions. Because of differences in available biological and threat information for federally listed species versus species of conservation concern, and because the Forest Service Handbook outlines different procedures to identify plan components necessary to provide for the two groups of species, we used different approaches in their analyses.

Indicators and Measures

For all at-risk plant species, we identified the extent and condition of habitat as indicators, which are direct measures of ecological conditions needed to provide for persistent populations. Furthermore, for most species, extent and condition of habitat typically constitute the best

[35] Groups or ranks in a biological classification into which related organisms are classified.

available scientific information indicating whether such populations will continue to persist with sufficient distribution in the plan area (36 CFR Sec. 219.19). Finally, we selected extent and condition of habitat as indicators because relative differences among alternatives could be readily compared.

We made qualitative rather than quantitative comparisons because the known distribution of many species is not spatially mapped and the programmatic nature of a forest plan does not direct activities in particular locations. To evaluate extent and condition of habitat, we relied strongly upon the findings for environmental consequences in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections. In other words, the extent and condition of each ecosystem or special ecosystem type served as the habitat indicator for individual species, and for assemblages of at-risk species and overall floristic diversity. However, the ecosystem types outlined in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections are roughly, but not exactly aligned with floristic geographic subdivisions (Baldwin et al. 2012), to which at-risk plant populations are often associated. Therefore, the extent and condition of floristic geographic subdivisions themselves are also discussed to reflect the habitat indicators.

Whitebark pine is a candidate species for federal listing under the Endangered Species Act, and an additional indicator of population trend was evaluated. For this species, some trend information related to management activities has been documented in the plan area and quantitative, species-specific information was available for analysis.

Determinations for each species of conservation concern consist of a persistence analysis, which examines whether plan components provide ecological conditions necessary to provide for the persistence of each species in the plan area. This information is found in the “Analytical Conclusions” section. It is important to note most of the species of conservation concern have small occurrence numbers and/or limited distribution. For these species, associated threats can cause substantial concern for persistence in the plan area. Threats in combination with a stochastic event could affect a substantial proportion of species of low occurrence or limited distribution on the national forest.

As described at the beginning of this “Wildlife, Fish and Plants” section, the primary context for the evaluation of at-risk species, including species of conservation concern, is that forest plan direction for ecological conditions provide for ecosystem integrity and ecosystem diversity. The 2012 Planning Rule requires that forest plan direction be integrated across resources and that the forest plan needs to provide for the ecological conditions that will provide for the persistence of at-risk species within the inherent capabilities of the forest plan area (36 CFR Sec. 219.5 and 219.8-219.9). The evaluation of forest plan direction that provides for species persistence is done first by examining the ecosystem level plan direction, conducted using habitat extent and condition as indicators. Where needed, individual species-specific plan direction is added.

For the ecosystem level approach, species were grouped by ecosystems described in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections and discussed in this section. The environmental consequence findings of those sections also compared existing and foreseeable future conditions of ecosystems to desired conditions, and this comparison was used as the basis of the coarse filter evaluation. This ecosystem approach assumes that persistence of species of conservation concern is broadly dependent upon the integrity of the ecosystems where they currently occur.

Because integrity of whole ecosystems does not necessarily ensure persistence of all species of conservation concern, particularly those with very limited distribution, we conducted additional analyses by special habitat and/or species-specific direction to ensure that persistence is provided for all plant species of conservation concern. The fine filter evaluation was conducted by analysis of (1) special habitats that support suites of some species of conservation concern, and (2) known threats to each individual species of conservation concern. Species were grouped by fine-scale habitats where possible, to enable a fine filter look at ecological conditions that affect populations. Documented threats that influence species trends in distribution and persistence were also evaluated. The plant rationale document (USDA Forest Service 2018b) lists each species' ecosystem, NatureServe rank, threats, and the occurrence information. Known threats to species of conservation concern were compared qualitatively by alternative.

For species that were previously listed as Forest Service Pacific Southwest Region sensitive species, but which were not identified as at-risk species under the 2012 Planning Rule, the rationale for this determination and an overview of those species are presented in the plant rationale document (USDA Forest Service 2018b) and briefly summarized above in the introduction section for this "Wildlife, Fish and Plants."

Analysis Area

In general, the analysis area for indirect effects includes all National Forest System lands managed by the Inyo National Forest.

Assumptions

- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions). However, there may be implications, or longer term environmental consequences, of managing the national forest under this programmatic framework. As a result, all effects discussed in this section are considered indirect effects or cumulative effects.
- The planning timeframe for the effects analysis is 10 to 15 years; other timeframes may be specifically analyzed depending on the resource and potential consequences.
- Monitoring identified in the plan monitoring program and any broader-scale monitoring will occur, and the land management plan will be amended, as needed during the life of the plan.
- Relevant considerations to the analysis that are common to all alternatives include: existing wilderness will continue to be managed as such; there will be a general increase in recreational demand as the human population size increases; weeds and weed seeds will continue to be deposited and spread onto and within the plan area; and climate change trends will continue as projected, with warming temperatures and reduced snowpack.
- Funding will be available to implement restoration measures, including nonnative invasive plant treatments identified as priorities because they pose substantial threats to the persistence of at-risk plant species.

Species Evaluated

A total of 106 at-risk plant species were identified on the Inyo National Forest; this includes one federally designated candidate species, whitebark pine, and 105 plant species of conservation concern.

Federally Listed and Candidate Plant Species

There are currently no federally listed plant species occurring in the plan area; there is one candidate species, whitebark pine (table 67). Candidate species are plants and animals for which the U.S. Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Candidate species do not have formal protection under the Endangered Species Act but the 2012 Planning Rule requires that forest plans are developed to conserve candidate species (36 CFR 219.9).

Ramshaw meadows abronia (*Abronia alpina*) was a candidate species during the assessment phase for plan development and revision but has since been removed from consideration as a candidate species by the U.S. Fish and Wildlife Service[36] and was added to the list of species of conservation concern on the Inyo National Forest due to concern for its persistence in the plan area.

Table 67. Federally designated plant species and critical habitat

Scientific Name	Common Name	Status	Critical Habitat	Principal Habitat
Pinus albicaulis	Whitebark pine	Candidate	Not applicable	Subalpine, alpine

Plant Species of Conservation Concern

The Inyo National Forest has 105 plant species of conservation concern on, comprising 97 flowering plants; 5 ferns, 2 mosses and lichen. Over 200 botanical species were considered for species of conservation status (FSH 1909.12, section 12.52c-d), as documented in the Rationales for Plant Species Considered for Species of Conservation Concern, Inyo National Forest (USDA Forest Service 2018b). The list of plant species of conservation concern[37] is presented in table 70, in the “Affected Environment” section.

Under the current forest plan, rare plants are provided for according to the direction for Region 5 sensitive species. Of the 67 sensitive plant species that occur in the Inyo National Forest plan area, 46 were carried forward as species of conservation concern. In addition, 59 species not previously categorized as Pacific Southwest Region sensitive species were added as species of conservation concern. The species of conservation concern lists are specific to each national forest, and species must be known to occur with the plan area. For that reason, some sensitive species may be identified as species of conservation concern on one national forest, while not on the neighboring national forest. The specific reasons a sensitive species was determined to meet or not meet the established criteria as a species of conservation concern are provided in the species rationales found in the plant rationale document (USDA Forest Service 2018b). A summary is provided in table 56.

Affected Environment

Although some concentrations of species can be identified on the Inyo National Forest (such as in alpine ecosystems of the White Mountains), at-risk plant species can be found in all floristic geographic subdivisions, and in all ecosystem types. The special habitats, or ecosystem types

[36] Federal Register: 80 FR 60834, Oct. 8, 2015

[37] Pacific Southwest Regional Forester signed list on January 2018.

called out in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections can sometimes host a number of at-risk plant species.

Floristic Diversity

The flora of the Inyo National Forest is notably diverse, reflecting the area’s complex geology, topography, and climate. The close juxtaposition of such variable habitats has created opportunities for genetic isolation and subsequent evolution. As a result, the area has an exceptionally high level of endemic species (unique to a place or region) relative to other regions of the United States (California Native Plant Society 2015). Inyo National Forest is situated at the intersection of California’s three major floristic provinces (Baldwin et al. 2012): California Floristic Province, Great Basin, and Desert.

Because many species of conservation concern have a greater affinity for floristic geographic subdivisions (like provinces) than for ecosystems, some detail is provided here on the subdivisions, which assisted in the evaluation of habitat condition and extent. The three major provinces and their respective regions that occur in the plan area host relatively distinct floras, although the transitions are not necessarily abrupt, resulting in some overlap, particularly where mountain passes or drainages support connectivity.

Figure 31 show the floristic geographic subdivisions represented in the plan area and table 68 displays the number of plant species tracked by the California Natural Diversity Database to show the relative diversity of plants in these provinces (Baldwin et al. 2012).

Table 68. Plant species diversity by floristic geographic province, region, and subdivisions[1]

Province	Region	Subregion[1]	No. Plant Species in CNDDB[2]	Area (acres)
California Floristic Province	Sierra Nevada	High Sierra Nevada (Central and Southern districts)	76	823,746
Great Basin	Eastern Sierra Nevada	White and Inyo Mountains	75	471,698
Great Basin	Eastern Sierra Nevada	Other Eastern Sierra Nevada (Mono Basin, Glass Mts., Eastern escarpment)	60	667,251
Desert	Mojave Desert	Mojave Desert (exc. Desert Mts.)	4	14,019

1. Spatial dataset used with permission from the Jepson Herbarium (Jepson Flora Project 2015).
2. CNDDB is the California Natural Diversity Database (California Department of Fish and Wildlife 2017b). Note many plants occur in more than one province.

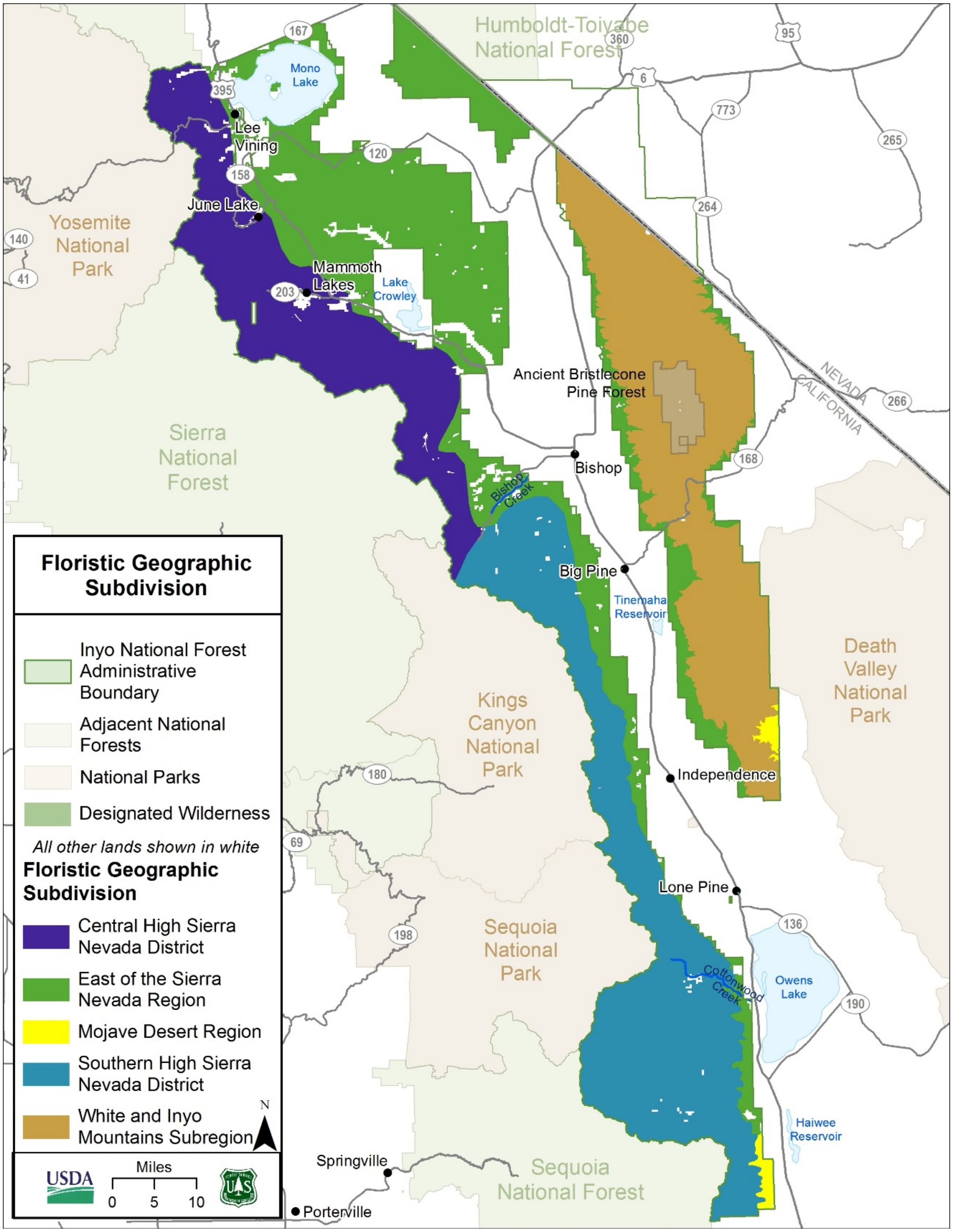

Figure 31. Floristic geographic subdivisions

The Sierra Nevada region, which occupies the majority of the plan area, is characterized primarily by igneous geology. The High Sierra Nevada subregion (central and southern districts) is topographically complex, spanning nearly 10,000 feet in elevation. Vegetation may be dominated by ponderosa pine, mixed conifer, Jeffrey pine, red fir, lodgepole pine, mountain hemlock, whitebark pine, foxtail pine, or western white pine. Treeless alpine areas, meadows, and riparian areas, are also common. The southern High Sierra Nevada subregion supports some pinyon pine and sagebrush. Although this region is the largest in size and supports about one-third of at-risk plant species on Inyo National Forest, the density of at-risk populations is not high in comparison to the Mojave Desert or White and Inyo Mountains subregions.

In the Eastern Sierra Nevada Region, the 10,000-foot elevation gradient is abrupt, creating rapid transitions from desert and sagebrush vegetation at the lowest elevations, to pinyon pine woodlands, coniferous forests, and alpine areas. The region includes most conifers found on the west side of the Sierra Nevada, but mixed conifer is relatively uncommon. This region is geologically complex, with significant volcanic, sedimentary, and metamorphic bedrock and soils represented. The White and Inyo Mountains subregion is situated in the rain shadow of the Sierra Nevada, and receives less precipitation, as evident in the arid-adapted vegetation, including pinyon-juniper, mountain mahogany, sagebrush, bristlecone and limber pine, and large expanses of high alpine areas.

Ecosystem Types

The floristic geographic subdivisions give an overview of the distribution of diversity in the plan area and assist with a broad, qualitative analysis. For further detailed analysis, plant species are aligned with ecosystem types classified in the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections. The ecological habitat types that host particularly high numbers of at-risk plant species are subalpine, sagebrush, alpine, and pinyon-juniper habitats. As discussed in the “Terrestrial Ecosystems” section, special habitats are limited, uncommon habitats that are important in providing unique conditions and may support concentrations of plant species of conservation concern. Examples of special habitats on the Inyo National Forest include alkali flats, caliche-covered clay soil mounds, pumice flats, and stabilized dunes. The ecosystem type associated with each plant species of conservation concern is included in table 70.

Status and Threats for At-risk Plant Species

Federally Listed and Candidate Plant Species

Whitebark pine is a candidate species for listing. There are no other federally listed plant species analyzed on the Inyo National Forest. A brief species summary is given here; a full species account with literature citations was provided during the assessment phase for forest plan revision and is included in the project record (USDA Forest Service 2013a). Although candidate species do not have formal protection under the Endangered Species Act, we included an analysis of whitebark pine in the biological assessment prepared for this project (USDA Forest Service 2017a). The information is briefly summarized below.

Whitebark pine is known to occur in the western mountains of the United States and Canada. In California, it occurs in the Klamath Range, Cascade Range, Warner Mountains, and Sierra Nevada. It is a slow-growing, long-lived conifer that tolerates poor soils, steep slopes, and windy exposures and is found at treeline and subalpine elevations throughout its range. On the Inyo National Forest, approximately 140,000 acres contain whitebark pine stands (table 69); about 37 percent of the extent of whitebark pine in California (Slaton, Gross, and Meyer 2014).

Approximately 86 percent of the whitebark pine on the Inyo National Forest occurs within wilderness. The remaining acres occur primarily either within ski areas, near high elevation reservoirs where day use activities are popular (such as Lake Sabrina, Saddlebag Lake, and South Lake), or at the lower elevations of the whitebark pine zone, where campgrounds and trailheads are often found (Onion Valley, Bishop Creek, and Rock Creek developed recreation sites). Some whitebark pine stands occur in the Glass Mountains.

Table 69. Distribution of whitebark pine on the Inyo National Forest and in California

Location	Acres
Inyo National Forest	139,922
In Wilderness on Inyo National Forest	120,137
Other National Forests in California	123,089
National Parks in California	107,438
California Total	372,035

Whitebark pine serves a number of important ecological functions, including snow retention, runoff regulation, soil temperature moderation, early colonization of disturbed sites, and forage and habitat for birds and mammals (Meyer 2013b). There are several major threats to whitebark pine, including attack by native bark beetles, climate change, fire suppression, and the introduced pathogen white pine blister rust (United States Department of the Interior 2011, 2016b). White pine blister rust is uncommon on the east side of the Sierra Nevada crest, including in whitebark pine in the plan area (Meyer 2013b). Whitebark pine of all age classes are adversely affected by high intensity fire, but burned areas provide a seedbed and are used by Clark’s nutcrackers as seed cache sites and can serve as regeneration sites. A climate-related threat is impacts to individuals from snow avalanches which will be influenced by climate change to the extent that patterns of snowfall and conditions that trigger avalanches change over time. Although each threat individually is problematic, the combined impacts pose a significant threat to species viability.

Whitebark pine population trend information from surveys conducted in the vicinities of June Mountain and Rock Creek indicate bark beetle attacks result in high mortality among medium- to large-diameter trees, with high survivorship in small trees (Meyer et al. 2014b). While there has been a trend of changing stand structure in some whitebark pine stands, there has been no clear evidence of range retraction or expansion. Mountain pine beetle mortality in stands of whitebark pine functioned to release saplings that were seed cached by Clark’s nutcrackers where saplings were many decades old and suppressed in growth by the overstory trees. These stands some showed signs of increased growth following release (MacKenzie 2014, Perkins 2015).

Plant Species of Conservation Concern

For each species of conservation concern, important information that contributes to the judgement of whether a substantial concern exists for the persistence of a given species includes the occurrences within the plan area, extent of habitat (broad ecosystems or ecosystem types as defined in the forest plan), and known threats. Table 70 displays the list of plant species of conservation concern with species grouped by known threats to persistence and principal ecological habitats on Inyo National Forest. This information is used in the analysis to evaluate how plan components provide for the ecological conditions needed by habitat type and addresses threats associated with those habitats. Within the threat column, we include identifying species with small occurrences and/or limited distribution.

No set number was used as a threshold for population size, but rather the context in which each species occurs was considered. Fundamental principles of conservation biology related to minimum population sizes to maintain viable populations and on causes of rarity were considered in these determinations (Rabinowitz 1981, Shaffer 1981), and (Wiens and Slaton 2012). Species carried forward to the list of species of conservation concern are those for which the identified threats were considered to at least in part affect local population persistence, thus contributing to the substantial concern for species persistence.

Table 70. Inyo National Forest plant species of conservation concern and threats by principal habitat type

Scientific Name	Common Name	Known Threats to Persistence	Principal habitats
Abronia alpina	Ramshaw Meadows abronia	Conifer encroachment; hydrologic alteration; climate change; small occurrence numbers	Subalpine; dry forb
Agrostis humilis	Alpine bentgrass	Climate change and related hydrologic alteration; social trails in meadows; packstock; small occurrence numbers	Alpine
Allium atrorubens var. *atrorubens*	Great Basin onion	Grazing; mining; small occurrence numbers	Mountain mahogany; subalpine; pinyon-juniper
Astragalus cimae var. *sufflatus*	Inflated Cima milk-vetch	Invasive species; small occurrence numbers	Pinyon-juniper
Astragalus inyoensis	Inyo milk-vetch	Mining; vehicles; restricted geographic range	Pinyon-juniper
Astragalus johannis-howellii	Long Valley milk-vetch	Grazing; small occurrence numbers	Sagebrush; alkali flat
Astragalus kentrophyta var. *elatus*	Spiny-leaved milk-vetch	Climate change; recreation; small occurrence numbers; soil degradation	Subalpine
Astragalus lemmonii	Lemmon's milk-vetch	Grazing; hydrologic alteration; few occurrence numbers	Sagebrush; alkali flat
Astragalus lentiginosus var. *kernensis*	Kern Plateau milk-vetch	Vehicles; climate change; drought; grazing	Subalpine; dry forb; lodgepole
Astragalus monoensis	Mono milk-vetch	Unauthorized OHV travel; drought; grazing; limited distribution	Jeffrey pine; sagebrush; dry forb; pumice flats
Astragalus ravenii	Raven's milk-vetch	Climate change; very small occurrence numbers; fragile habitat	Alpine; subalpine
Astragalus serenoi var. *shockleyi*	Shockley's milk-vetch	Mining; grazing; invasive species; small occurrence numbers	Pinyon-juniper; xeric shrub/blackbrush
Astragalus subvestitus	Kern County milk-vetch	Grazing; unauthorized OHV travel; very few occurrences	Subalpine; dry forb
Boechera bodiensis (Arabis b.)	Bodie Hills rockcress	Climate change; few occurrences	Pinyon-juniper; sagebrush
Boechera pendulina	Rabbit-ear rockcress	Climate change; few occurrences	Alpine
Boechera pinzliae	Pinzl's rockcress	Climate change; few occurrence numbers	Alpine; subalpine
Boechera shockleyi (Arabis s.)	Shockley's rockcress	Mining; vehicles; small occurrence numbers	Xeric shrub/blackbrush

Scientific Name	Common Name	Known Threats to Persistence	Principal habitats
Boechera tiehmii (Arabis t.)	Tiehm's rockcress	Climate change; small occurrence numbers	Alpine
Boechera tularensis	Tulare rockcress	Grazing; climate change; very few occurrence numbers	Subalpine; meadow
Botrychium ascendens	Upswept moonwort	Hydrologic alteration; trampling; unauthorized OHV travel; severe soil disturbance; small occurrence numbers	Subalpine; meadow
Botrychium crenulatum	Scalloped moonwort	Hydrologic alteration; trampling; unauthorized OHV travel; severe soil disturbance	Subalpine; meadow
Botrychium lineare	Slender moonwort	Hydrologic alteration; trampling; unauthorized OHV travel; severe soil disturbance; one occurrence of a single plant	Subalpine; meadow
Botrychium minganense	Mingan moonwort	Hydrologic alteration; trampling; unauthorized OHV travel; severe soil disturbance; small occurrence numbers	Subalpine; meadow
Bruchia bolanderi	Bolander's bruchia	Hydrologic alteration; recreation impacts in meadow; few occurrences	Alpine; subalpine
Calochortus excavatus	Inyo County star-tulip	Grazing; hydrologic alteration; small occurrence numbers	Sagebrush; xeric shrub/blackbrush; meadow
Calyptridium pygmaeum	Pygmy pussypaws	Climate change; trampling; small occurrence numbers	Alpine; subalpine
Carex davyi	Davy's sedge	Hydrologic alteration; grazing; small occurrence numbers	Subalpine; meadow
Carex duriuscula	Spikerush sedge	Grazing; hydrologic alteration; small occurrence numbers	Sagebrush; subalpine; meadow
Carex idahoa	Idaho sedge	Grazing; climate change; small occurrence numbers	Sagebrush; subalpine; meadow
Carex petasata	Liddon's sedge	Grazing; climate change; small occurrence numbers	Pinyon-juniper; subalpine; meadow
Carex praticola	Northern meadow sedge	Grazing; climate change; small occurrence numbers	Subalpine; meadow
Carex scirpoidea ssp. pseudoscirpoidea	Western single-spiked sedge	Grazing; climate change; small occurrence numbers	Sagebrush; subalpine
Carex stevenii	Steven's sedge	Climate change; small occurrence numbers; hydrologic alterations	Alpine
Carex tiogana	Tioga Pass sedge	Climate change; recreation; small occurrence numbers	Alpine; subalpine
Carex vallicola	Western valley sedge	Hydrologic alteration; climate change; small occurrence numbers	Sagebrush; subalpine
Chaetadelpha wheeleri	Wheeler's dune-broom	Extremely restricted; soil degradation from vehicles and solar energy development. Possibly threatened by nonnative plants. small occurrence numbers	Sagebrush; sand dune
Claytonia megarhiza	Fell-fields claytonia	Climate change; small occurrence numbers	Alpine
Cordylanthus eremicus ssp. kernensis	Kern Plateau bird's-beak	Grazing; recreation; climate change; small occurrence numbers	Alpine; subalpine

Scientific Name	Common Name	Known Threats to Persistence	Principal habitats
Crepis runcinata ssp. hallii	Hall's meadow hawksbeard	Grazing; unauthorized OHV travel; hydrologic alteration; small occurrence numbers and restricted habitat	Sagebrush; alkali flat
Cuniculotinus gramineus (Chrysothamnus g.)	Panamint rock-goldenrod	Mining; invasive species; small occurrence numbers	Mountain mahogany; subalpine; carbonate
Cymopterus globosus	Globose cymopterus	Grazing; hydrologic alteration; Very few occurrence numbers	Sagebrush
Dedeckera eurekensis	July gold	Mining; recreation; invasive species; small occurrence numbers and limited distribution	Xeric shrub/blackbrush; carbonate
Draba californica	California draba	Climate change; limited distribution	Sagebrush; alpine
Draba monoensis	White Mountains draba	Climate change; few occurrences	Alpine
Draba sharsmithii	Mt. Whitney draba	Climate change; small occurrence numbers; trail construction and maintenance; trampling by hikers	Alpine
Dryopteris filix-mas	Male fern	Climate change; possible hydrologic concerns (drying of springs); few occurrences	Subalpine
Ericameria gilmanii	Gilman's goldenbush	Invasive species; mining; Very few populations	Pinyon-juniper; subalpine
Erigeron compactus	Compact daisy	Invasive species; climate change; small occurrence numbers and limited habitat	Sagebrush; pinyon-juniper; carbonate; alkali flat
Erigeron uncialis var. *uncialis*	Limestone daisy	Very few occurrences and limited distribution	Sagebrush; carbonate
Eriogonum alexandrae (E. ochrocephalum var. *ochrocephalum)*	Alexander’s buckwheat	Invasive species; trampling (wild horses/cattle); unauthorized OHV travel; few occurrences	Sagebrush; pinyon-juniper; caliche-covered clay soil mounds
Eriogonum mensicola	Pinyon Mesa buckwheat	Mining; recreation; invasive species; small occurrences numbers	Pinyon-juniper
Eriogonum wrightii var. *olanchense*	Olancha Peak buckwheat	Climate change; small occurrence numbers	Alpine; subalpine
Goodmania luteola	Yellow spinecape	Grazing; small occurrence numbers	Sagebrush
Greeneocharis circumscissa var. *rosulata*	Rosette cushion cryptantha	Grazing; trampling; climate change; small occurrence numbers	Alpine; dry forb; subalpine
Grusonia pulchella	Beautiful cholla	Grazing; few occurrence numbers	Sagebrush; xeric shrub/blackbrush
Hackelia brevicula	Poison Canyon stickseed	Grazing; climate change; small occurrence numbers	Sagebrush; subalpine
Hackelia sharsmithii	Sharsmith's stickseed	Recreation impacts along trails; small occurrences	Sagebrush; subalpine
Helodium blandowii	Blandow's bog moss	Hydrologic alteration; grazing; small occurrence numbers	Subalpine; meadow
Hesperidanthus jaegeri	Jaeger's hesperidanthus	Climate change; invasive species; few occurrences and limited habitat	Pinyon-juniper; subalpine; carbonate
Horkelia hispidula	White Mountains horkelia	Grazing; climate change; limited distribution	Sagebrush
Hulsea brevifolia	Short-leaved hulsea	Trampling; altered fire regime; small occurrence numbers	Subalpine; mixed conifer

Scientific Name	Common Name	Known Threats to Persistence	Principal habitats
Hulsea vestita ssp. inyoensis	Inyo hulsea	Mining; small occurrence numbers	Pinyon-juniper; sagebrush
Ivesia campestris	Field ivesia	Grazing	Subalpine; meadow
Ivesia kingii var. *kingii*	Alkali ivesia	Grazing; unauthorized OHV travel; hydrologic alteration; small occurrence numbers	Sagebrush; alkali flat
Jamesia americana var. *rosea*	Fivepetal cliffbush	Climate change; recreation trampling; small occurrence numbers	Alpine; subalpine
Kobresia myosuroides (K. bellardii)	Seep kobresia	Small occurrence numbers	Subalpine; meadow
Ladeania lanceolata (Psoralidium lanceolatum)	Lance-leaved scurf-pea	Wild horse; grazing; limited occurrence	Sagebrush; sand dunes
Lomatium foeniculaceum ssp. inyoense	Inyo biscuitroot	Soil degradation; climate change	Sagebrush; subalpine
Lupinus duranii	Mono Lake lupine	Unauthorized OHV travel; grazing; invasive species; road maintenance	Jeffrey pine; sagebrush; dry forb; pumice flats
Lupinus padre-crowleyi	Father Crowley's lupine	Livestock trampling; altered fire regime; limited occurrence numbers	Sagebrush; Jeffrey pine
Mentzelia inyoensis	Inyo blazing star	Invasives; very small occurrence numbers and limited distribution.	Pinyon-juniper; sagebrush (calcareous pumice)
Mentzelia torreyi	Torrey's blazing star	Invasives; vehicles; grazing and trampling and limited distribution	Sagebrush; pinyon-juniper; caliche-covered clay soil mounds
Monardella beneolens	Sweet-smelling monardella	climate change; small occurrence numbers	Alpine; subalpine
Oreocarya roosiorum (Cryptantha roosiorum)	Bristlecone cryptantha	Climate change; small occurrence numbers	Subalpine
Oxytropis deflexa var. *sericea*	Blue pendant-pod oxytrope	Grazing; small occurrence numbers	Subalpine; meadow
Penstemon calcareus	Limestone beardtongue	Invasive species; burros; very small occurrence numbe	Xeric shrub/blackbrush; carbonate
Petrophyton caespitosum ssp. acuminatum (P. acuminatum)	Marble rockmat	Very small occurrence numbers; competition by invasives	Mountain mahogany; subalpine; pinyon-juniper
Phacelia inyoensis	Inyo phacelia	Grazing; vehicle use; very few occurrences	Sagebrush; meadow
Phacelia monoensis	Mono phacelia	Restrictive habitat and limited distribution	Pinyon-juniper
Phacelia nashiana	Charlotte's phacelia	Invasives: small occurrences	Xeric shrub/blackbrush
Physaria ludoviciana	Silver bladderpod	Wild horses; only one occurrence recorded	Sagebrush; caliche-covered clay soil mounds
Physocarpus alternans	Nevada ninebark	Very small occurrence numbers; invasive species; climate change	Pinyon-juniper; carbonate
Plagiobothrys parishii	Parish's popcornflower	Climate change; hydrological alteration; grazing; very small occurrence numbers and limited distribution	Xeric shrub/blackbrush;
Polemonium chartaceum	Mason's sky pilot	Climate change; grazing; recreation; small occurrence numbers	Alpine

Scientific Name	Common Name	Known Threats to Persistence	Principal habitats
Polyctenium williamsiae	Williams' combleaf	Climate change; limited habitat; grazing; unauthorized OHV travel; small occurrence numbers	Sagebrush
Populus angustifolia	Narrow-leaved cottonwood	Hydrologic alteration, altered fire regime; one occurrence of all male plants	Pinyon-juniper; sagebrush
Potentilla morefieldii	Morefield's cinquefoil	Climate change; grazing; recreation	Alpine; carbonate
Potentilla pulcherrima	Beautiful cinquefoil	Grazing; erosion; small occurrence numbers	Sagebrush; alpine
Ranunculus hydrocharoides	Frog's-bit buttercup	Hydrologic alteration; drought and horse trampling identified as possible threats; small occurrence numbers	Pinyon-juniper
Sclerocactus polyancistrus	Redspined fishhook cactus	Horticultural collection; vehicles; grazing; insect herbivory	Sagebrush; xeric shrub/blackbrush
Solorina spongiosa	Fringed chocolate chip lichen	Limited occurrence on INF; single occurrence along roadside in recreation area; recreation trampling	Subalpine
Sphaeromeria potentilloides var. *nitrophila*	Fivefinger chickensage	Unauthorized OHV travel; grazing	Sagebrush; alkali flat; meadow
Sphenopholis obtusata	Prairie wedge grass	Grazing; hydrologic alteration; small occurrence numbers	Sagebrush; pinyon-juniper
Stipa divaricata	Small-flowered rice grass	Grazing; climate change; very small occurrences numbers	Sagebrush
Streptanthus gracilis	Alpine jewelflower	Hydrologic alteration; climate change; recreational trampling; limited distribution	Alpine
Streptanthus oliganthus	Masonic mountain jewelflower	Grazing; mining; erosion; small occurrence numbers	Pinyon-juniper
Taraxacum ceratophorum	Horned dandelion	Grazing; hydrologic alteration; small occurrence numbers & distribution	Subalpine
Tetradymia tetrameres	Dune horsebrush	Invasive species; unauthorized OHV travel; climate change; small occurrence numbers and limited distribution	Sand dune; xeric shrub/blackbrush
Thelypodium integrifolium ssp. complanatum	Foxtail thelypodium	Very few occurrence numbers; grazing; hydrologic alteration	Pinyon-juniper; sagebrush
Thelypodium milleflorum	Many-flowered thelypodium	Invasive species; wild horse browsing; unauthorized OHV travel; vegetation management; climate change; small occurrences	Sagebrush; xeric shrub/blackbrush; caliche-covered clay soil mounds
Townsendia leptotes	Slender townsendia	Climate change; limited distribution	Alpine
Transberingia bursifolia ssp. virgata	Virgate halimolobos	Grazing; hydrologic alteration; small occurrence numbers	Pinyon-juniper; subalpine; meadow
Trichophorum pumilum	Little bulrush	Hydrologic alteration; grazing; small occurrence numbers	Subalpine
Trifolium dedeckerae (T. kingii ssp. dedeckerae)	Dedecker's clover	Grazing; road maintenance; climate change; invasive species	Alpine; subalpine; sagebrush;
Viola purpurea ssp. aurea	Golden violet	Grazing; vehicles; small occurrence numbers	Sagebrush

As previously discussed, the at-risk species specific, or fine filter, evaluation was conducted by analysis of (1) special habitats that support suites of some species of conservation concern on the Inyo National Forest, and (2) known threats to each individual species of conservation concern. In table 70, special habitats that support some species of conservation concern are included in the principal habitat column. The major threat groups and numbers of species documented to be affected by the threat are displayed in table 71. Threats to plant species of conservation concern from recreation activities include trampling, ground disturbance, plant harvesting, and introduction of weeds, including by hikers, stock, and unauthorized off-highway vehicle travel. Areas with developed facilities, like campgrounds, make areas more accessible and concentrate use that can impact plant habitat. Dispersed camping has similar impacts. Soil disturbance also occurs during vegetation management treatments and prescribed burning activities, including during associated road building or maintenance, or line construction. Roads used for vegetation management treatments may also provide an avenue for invasive plant species. Nonnative invasive plant species can displace native plant communities through resource competition, which could result in the loss of native at-risk species habitat, loss of pollinators, decreased plant diversity, and decreased rare plant species viability. Invasive species management activities may include herbicide spraying and mechanical ground disturbance that could impact native species.

Table 71. Known threats to plant species of conservation concern, as documented in best available scientific information*

Threat	Number of Species Documented to be Affected by Threat
Altered fire regime	3
Climate change	45
Conifer encroachment	1
Drought	4
Erosion/soil degradation	9
Few occurrences and/or limited distribution**	94
Fragile habitat	1
Grazing	46
Horticultural collection	1
Hydrologic alteration	27
Insect herbivory	2
Invasive species	19
Livestock trampling	3
Mining	10
Recreation (trails, trampling)	20
Road maintenance	2
Unauthorized OHV travel	14
Wild horses, burros	4

***** Most species of conservation concern on the Inyo National Forest are affected by more than one threat.

****** All species of conservation concern are considered rare to some degree; occurrence numbers or restricted ranges are considered with various factors that threaten persistence in the plan area.

Environmental Consequences to At-risk Plant Species

Consequences to Whitebark Pine (Candidate Species)

Consequences Common to All Alternatives

Whitebark pine are periodically monitored by the Regional Ecology Program and it is recognized as a species highly susceptible to climate change (USDI Fish and Wildlife Service 2016b). Whitebark pine will continue to be evaluated by the Forest Health Protection program and by forest pathologists for tree mortality and susceptibility to bark beetle attack and to monitor for white pine blister rust. As needed, Forest Health Protection staff may recommend management or restoration projects which may be considered and implemented by the Inyo when feasible.

The extent of impacts of recreation management on whitebark pine is not known but they occur within and near several popular campgrounds and recreation sites, ski areas, and trails. Whitebark pine trees may be affected by incidental damage by recreationists within campgrounds and during campground maintenance, including pruning or removal when they create safety hazards. Whitebark pine can also be affected by collection and use of whitebark pine branches and downed wood for campfires by recreationists. However, since 2002, the Inyo has implemented elevation-based campfire restrictions in wilderness areas in part to reduce the impacts of depletion of downed wood and ground litter in the elevations where whitebark pine occurs.

Where whitebark pine occurs along roads, trails, within utility corridors, and near facilities, they may be pruned or removed where they contribute to safety hazards and cannot be avoided. In general, efforts are made to protect mature trees and the plan revision alternatives include a specific desired condition to protect mature cone-bearing trees where possible.

Consequences Specific to Alternative A

Alternative A has general direction to protect the diversity of plant communities and seral stages, but has no direction specific to whitebark pine. Projects and activities would be guided by agency direction for managing candidate species and direction to manage Regional Forester’s sensitive species. As a sensitive species, project proposals would be evaluated at the project level to ensure they do not lead to a trend towards federal listing. Short-term effects would be minimal to whitebark pine, because small-scale restoration projects and species monitoring would continue to occur under this alternative and projects that could affect whitebark pine would be evaluated to ensure it would contribute to the conservation of the species. Where whitebark pine occurs in recreation sites, including ski resorts under special use permit, and near roads and other infrastructure, they will continue to be pruned or removed where needed to provide for public safety. Where possible, projects would continue to be designed to reduce competing vegetation to increase resilience and create suitable seedbeds to support natural regeneration as has occurred in recent projects in the June Lakes area.

The current forest plan only defines fire management zones around communities. No specific forest plan direction exists to guide fire management related to whitebark pine in the majority of the areas where whitebark pine occurs, which is primarily located in designated wilderness and remote alpine and subalpine habitats away from communities. When fires occur in these areas away from communities, fire management decisions are guided by agency policies and procedures where naturally ignited wildfires are considered for management to meet resource objectives on a case-by-case basis. Since forest plan resource objectives for wildfire management are only general in nature, many wildfires continue to be suppressed, slowing the restoration of fire as an ecosystem function to many forest landscapes. Continuing to suppress wildfires allows vegetation to continue to become denser which can increase competition by encroaching trees and shrubs and increase water stress to whitebark pine. Burned areas that create exposed mineral soil are also important for seed caching by animals, particularly the Clark's nutcracker, which is an important mechanism for whitebark pine regeneration.

Because it lacks an emphasis on whitebark pine conservation and many wildfires that burn in whitebark pine habitats will likely continue to be suppressed, alternative A would protect and restore the least amount of whitebark pine habitats but would still provide the ecological conditions necessary to conserve candidate species and would maintain or restore their habitats in the plan area to contribute to preventing them from being federally listed.

Consequences Common to Alternatives B, B-modified, C, and D

Desired conditions for the alpine and subalpine zone provide for healthy whitebark pine, including resilience to moisture stress, drought, and bark beetles, and resistance to white pine blister rust. The desired condition for the alpine and subalpine vegetation zone provides for protection and conservation of genetic diversity through the maintenance of mature cone-bearing trees. This is important to ensure sufficient seeds for caching by Clark's nutcrackers to aid in natural regeneration and to maintain genetic diversity.

Since most of the whitebark pine occurs within wilderness, no direct active management other than restoring fire as an ecosystem process will likely occur to move towards the vegetation desired conditions that would benefit whitebark pine. Compared to alternative A, the plan revision alternatives would better reduce the threat of high-intensity fire, and to some degree other threats, because of the emphasis on ecosystem restoration through the use of prescribed fire and wildfire managed to meet resource objectives. The latter is especially beneficial for whitebark pine because this is the primary restoration treatment in designated wilderness areas, where much of the whitebark pine occurs. As a result, there would be a positive effect to whitebark pine habitat quality and population trend to the extent that fire is restored within the natural range of variation.

In general, limited vegetation management to reduce stand densities is expected to occur in stands with whitebark pine. Outside of wilderness, vegetation projects could be designed to reduce stand density of trees to lessen competition and increase the resilience of whitebark pine. This type of active management is generally limited because of difficult access by equipment and the higher costs of vegetation management due to limited vegetation management infrastructure. When projects are designed in the alpine and subalpine ecological zone, desired conditions will function to guide them to consider the seral stages of whitebark pine and ensure that regeneration is likely to continue to occur which will increase the likelihood of climate adaptation (Brautigam et al. 2013). Thinning of mature trees has been observed to improve whitebark pine regeneration in the June Mountain area (MacKenzie 2014) where suppressed sapling sized trees were released to grow, even though they were fairly old.

The forest plan includes a goal to collaboratively develop a regional whitebark pine conservation and restoration strategy. This strategy is envisioned as a regional approach to the rangewide restoration strategy developed in 2012 (Keane et al. 2012) and would cover whitebark pine across its range in California. It would likely identify habitat management objectives or habitat goals and tactical practices that could be implemented to conserve whitebark pine. If such habitat management objectives or habitat goals were developed, they would be considered in the design of projects as appropriate. Any tactical practices could be considered and implemented in future projects unless they are inconsistent with an existing standard or guideline, in which case an amendment to the forest plan may be considered. This would provide additional assurances that whitebark pine are conserved on Inyo National Forest. Although the need to develop a regional conservation strategy is currently recognized, there is no specific plan direction in alternative A and it may be less likely to occur without the added recognition and emphasis in the forest plan.

Therefore, under alternatives B, B-modified, C, and D, greater acreage of wildfire managed to meet resource objectives may potentially result in improved resilience and regeneration of whitebark pine. This factor is expected to result in a moderate, but site-specific upward trend in whitebark pine vigor and reproduction. As a result, these alternatives would have some positive short- and long-term effects to whitebark pine habitat extent and condition.

Consequences Specific to Alternative B

Alternative B would allow for vegetation management in whitebark pine stands to improve habitat quality and stand structure, providing improved resilience to bark beetles and reducing drought susceptibility, especially to mature trees. Compared to alternative C, greater potential for mechanical pre-treatment could allow for more acreage to be treated and restored. These areas are still relatively limited, but include some whitebark stands in the vicinity of ski areas and other nonwilderness, high-elevation sites. As a result, there would be some beneficial effects for habitat condition and population trend under this alternative.

The majority of the wilderness areas and remote areas where whitebark pine occurs are in the Wildfire Maintenance Zone and the Wildfire Restoration Zone where the desired conditions are to manage conditions such that wildland fire predominately has a positive benefit to ecosystems and resources. Using the full range of wildfire management strategies and tactics encouraged by the desired conditions, it is expected that more wildfires will be managed within these zones to meet resource objectives than is currently occurring. The desired conditions support developing resource objectives that will identify the risks and benefits to whitebark pine from wildfire which will allow more adaptive and responsive wildfire management decisions, including when managing wildfires can restore ecological conditions favorable to whitebark pines. As more wildfires are managed and more areas have burned, future fires are expected to burn more similar to the natural range of variation, with a more varied mix of fire severities more responsive to the scattered and more heterogeneous upper elevation forest conditions. This should lessen the risks of large high severity wildfires that could affect large areas of whitebark pine to a greater extent than would occur under alternative A.

Consequences Specific to Alternative B-modified

Effects to whitebark pine would be very similar to alternatives B. The strategic fire management zones where whitebark pine occurs are similar to alternative B but with slightly more areas identified as wildfire restoration zone instead of wildfire maintenance zone. This recognizes that some wildfires may still burn under conditions that may need suppression actions because they would not be able to meet resource objectives or may need additional fuels management or strategic fire treatments to reduce the risks of managing wildfires to meet resource benefits. The expected result however is that wildfires that burn near areas with whitebark pine would be managed similarly to alternative B because fire management decisions would be based upon the ability to safely manage naturally ignited wildfires that would burn under conditions similar to those expected under the natural range of variation. Since there would be no difference between alternatives for the amount of active fuels management within wilderness or remote areas with little access, the consequences would be similar to alternative B.

Consequences Specific to Alternative C

Effects to whitebark pine would be very similar to alternatives B. Under alternative C, there may be slightly fewer opportunities for whitebark pine restoration using prescribed fire, because greater restrictions for mechanical pre-treatment may preclude the introduction of fire that would be safe and of low to moderate severity. This would only affect places outside of wilderness where mechanical treatment could occur. Under alternative C, hand treatments would be favored in lieu of mechanical treatments and may be sufficient to rearrange fuels to reduce the risk of damage to mature whitebark pines in some situations, but may be at higher costs of implementation limiting the extent of restoration completed with available funding. As a result, there could be fewer positive effects for whitebark pine habitat condition and population trend compared to alternatives B, B-modified, or D.

Alternative C uses the same wildfire maintenance zone as alternative B-modified where much of the whitebark pine occurs. Most of the remaining forest where whitebark pine occurs would be in the general wildfire zone where wildfire risk is more variable and there are less clear resource objectives. However, the intent of fire management within this zone is similar to alternative B-modified, to restore fire as an ecosystem function, so opportunities and outcomes for managing naturally ignited wildfires in the occupied portions of this zone would likely be similar to alternative B-modified.

Consequences Specific to Alternative D

Effects to whitebark pine would be very similar to alternatives B, with greater potential for whitebark pine restoration projects that require mechanical pre-treatment than the other alternatives. There would be slightly greater opportunity for proactive restoration for whitebark pine than the other alternatives, at least in the 14 percent of that ecosystem type that occurs outside wilderness.

The strategic wildfire management zones would be the same as alternative B-modified and consequences for management wildfire would be similar for the whitebark pine that occur in the wildfire maintenance zone. Where the whitebark pine occurs in the wildfire restoration zone outside of designated wilderness there may be more opportunity to manage wildfires to meet resource objectives to the extent that additional strategic vegetation and fuels treatments occur and to the extent that more wildfires are managed over time. This would benefit whitebark pine by restoring fire to the landscape which would reduce vegetation density and increase stand resilience and also create more suitable seedbeds for natural regeneration.

Consequences to Plant Species of Conservation Concern

Consequences Common to all Alternatives

All alternatives would incorporate at-risk species information from the California Natural Diversity Database, the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

All alternatives include fuels reduction and vegetation treatments designed to contribute to the restoration of a more resilient landscape. The amount of potential treatment, method of treatment, and priority locations for treatment, varies by alternative as discussed by alternative below.

Travel management and the authorized motorized route system will be the same under all alternatives. If substantial impacts to plant species of conservation concern from use of the authorized motorized route system are discovered, they would be addressed through developing site specific mitigations and, if needed, through site-specific changes in the authorized motorized route system following procedures of the Travel Management Rule.

Utilization of special forest products and personal-use fuelwood would generally remain similar to current conditions, with minimal increases expected due to population trends. The impacts to plant species of conservation concern are difficult to assess for dispersed personal firewood collection by individuals; this is assessed and managed when planning vegetation and fuels projects that will create piles or collection sites open to public gathering. The potential impacts to plant species of conservation concern would be considered during site-specific planning for those projects with mitigations to minimize or avoid impacts incorporated into project design.

There will be no changes to the current direction for mining. The impacts of authorized mining activities to plant species of conservation concern would be considered and mitigations required as part of decisions to authorize permits for activities and uses.

Consequences from grazing would be similar for all alternatives. All alternatives provide for mitigating effects to at risk plants from grazing and no alternative is expected to change the amount of permitted livestock use. Similarly, all alternatives include taking an approach to controlling invasive species and preventing their introduction.

Ramshaw Meadows Abronia

There is additional management guidance for Ramshaw Meadows abronia. A conservation agreement between the Inyo National Forest and the Sacramento Office of the U.S. Fish and Wildlife Service was signed in 2015 for this species (USDA Forest Service and USDI Fish and Wildlife Service 2015), and that agreement is currently in place and applies to all alternatives. Among the management actions in the agreement designed to protect the species are:

1. protection of the Ramshaw Meadow ecosystem
2. management of adverse effects of camping and hiker and packstock trampling
3. management of past and potential future livestock grazing (at the present date, livestock grazing is not permitted in the area)
4. management of conifer encroachment
5. study of climate change effects

Regular species monitoring is an essential component of the agreement. As a result, all alternatives would have positive short- and long-term effects to Ramshaw Meadows abronia habitat extent and quality.

Since 1985, species monitoring of Ramshaw Meadows abronia has occurred at least every 3 years, with total population estimates ranging from about 50,000 to 160,000 (USDA Forest Service and USDI Fish and Wildlife Service 2015). Although approximate 10-year cycles in peak population numbers are evident during this time period, no significant correlation has been detected between population trend and precipitation, or potential threats identified to the species. As a result, under all alternatives there is not expected to be a change in population trend.

Consequences to Floristic Geographic Subdivisions

Though none of the alternatives authorize specific actions that may affect individual species, this analysis includes an integrated look at potential effects to floristic biogeographic subregions and diversity that might be most affected by the alternatives. In addition, we analyze differences between alternatives in their effects to special habitats that host at-risk plants.

Compared to alternative A, alternatives B, B-modified, C, and D increase the pace and scale of restoration using fire. This may affect Sierra Nevada montane forests composed of dry mixed conifer, Jeffrey pine, red fir, lodgepole pine, and mountain mahogany vegetation types more strongly than other ecosystems because forests there are more strongly departed from desired conditions (table 24 and table 25). These ecosystems occur in the High Sierra Nevada floristic biogeographic subregion, and host about 35 percent of at-risk plant species (table 68). Some species, like *Hulsea brevifolia*, have been impacted by altered fire regimes and will benefit from restoration treatments using fire.

Particularly high densities of at-risk plant species occur in the subalpine and alpine zones of the High Sierra Nevada and White, Inyo, and Glass Mountains in the Great Basin, as well as sagebrush, pinyon-juniper ecosystem types and special habitats. Among the threats identified to species in these ecosystems is climate change. Alternatives B, B-modified, C, and D include plan direction aimed at increasing ecosystem resilience to climate change which will lessen the risks to species persistence slightly better than alternative A, which does not include specific direction to consider climate change.

Dispersed and developed recreation is expected to increase to some degree under all alternatives due to increasing human populations and recreation demand in the future. Some habitats like meadows, riparian areas, and rock outcrops are often places where recreation is more frequent or intense. Increased recreation activities can have direct negative effects to at-risk plant habitat extent or quality, due to trampling or habitat alterations; or can have indirect negative effects through the introduction or increases of invasive plants. Because these habitats may host clusters of at risk-plants, and because these areas may have especially high concentrations of recreational activities, forest plan direction and guidance under alternatives B, B-modified, C, and D, would provide for the continued persistence of at-risk species that occur there. For example, plan direction to mitigate these threats would include avoiding fire management activities in riparian conservation areas and meadows except when necessary to protect life and property. This includes avoiding activities such as line construction and staging areas and taking extra measures to avoid spread of invasive plants. In addition, direction in the plan revision alternatives for sustainable recreation recognizes the need for mitigation of some recreational activities where they adversely impact and jeopardize the persistence of at-risk species. Plan direction guides projects to consider a wide range of management responses to minimize impacts and does not solely require avoidance. Under alternative A, similar efforts and consequences described above are guided by direction focused on Pacific Southwest Region sensitive species.

Consequences Specific to Alternative A

Under alternative A, the Inyo National Forest would continue to manage a total of 67 Forest Service plant sensitive species, some of which have no known occurrence in the plan area. This alternative would consider fewer rare plants in the project planning process compared to the 105 plant species of conservation concern considered by the other alternatives. At the programmatic level, species management guides are developed for Forest Service sensitive species with recommendations for management and monitoring. In general, avoidance, rather than restoration, of Forest Service sensitive species at the project level is emphasized. Alternative A requires project level assessment of effects to sensitive species compared to alternatives B, B-modified, C, and D that rely more strongly on the achievement of desired conditions at the ecosystem scale and within special habitats to provide for species persistence, with project-level protections applied when necessary.

Since the existing management direction under alternative A would not direct the Inyo to adequately manage recreation opportunities and settings, there is more uncertainty in how recreation would adaptively manage new and emerging uses. For example, there would be uncertainty when and how to respond to changing or emerging unmanaged recreation uses that have potential ecological effects, since it would likely be addressed through analysis of effects on a project-by-project basis.

Alternative A would provide forestwide direction and guidance to address noxious weeds, including those that affect at-risk plant species. Forest plan direction requires individual projects to have a noxious weed risk assessment and direction to minimize and mitigate the risk of weed spread and control new infestations. Treatment efforts for noxious weeds are localized and limited by available funding.

Consequences Common to Alternatives B, B-modified, C, and D

A total of 105 plant species of conservation concern were identified in the plan area (table 70) for alternatives B, B-modified, C, and D. The list of plant species of conservation concern differs from the current (alternative A) list of Regional Forester's plant sensitive species for the Inyo National Forest. As previously discussed, the plant species of conservation concern list includes 46 of the 67 plant sensitive species that are included in alternative A. The 105 plant species of conservation concern, known threats to the persistence of each plant species of conservation concern, and primary habitat is included in (table 70) and a summary of the number of species affected by a known threat is provided in (table 71).

The plan revision alternatives are designed to maintain key ecosystem characteristics and ecosystem functions in order to maintain biodiversity of Inyo National Forest, thus providing for habitat needs of diverse native animal and plant species. This ecosystem, or course filter, approach focuses on managing for conditions consistent with the natural range of variation at the landscape scale, with the expectation that the needs and functional capacity of most organisms would be fulfilled. Ecosystem direction in combination with at-risk species, or fine filter, direction and direction for other resources is designed to promote resilient intact ecosystems, balance the needs of at-risk species with other resource uses and ecological processes, and mitigate risk to persistence from land management activities and other disturbance, including activities that increase spread of invasive species or impacts from management and recreational activities. The list of primary ecosystem and at-risk species specific plan components that contribute to providing for the habitat needs and protection of plant species of conservation concern is displayed in appendix F of volume 2. Plan direction would provide for ecosystems and habitat conditions resilient to disturbance (both natural and human caused) and the interrelated effects of climate change, and to mitigate site specific effects that might occur during projects or forest management activities.

Plan components related to plant species of conservation concern are similar for all the plan revision alternatives. For some plan direction, there are slight differences in category of plan component between some plan revision alternatives. For example, a guideline for alternatives B, C and D has become a standard in alternative B-modified. Differences are described in individual alternative sections.

For the plan revision alternatives, forestwide "Terrestrial Ecosystems and Vegetation" plan direction is course filter direction that covers all ecosystem types. Direction for all plant species includes direction to provide vegetation structure and composition that is resilient to climate change and other stressors, including altered fire regimes, drought, and flooding in riparian systems; ecosystems retain their essential components, processes and functions; the landscape contains a mosaic of vegetation types and structures; fire occurs within an ecologically appropriate regime of frequency, extent, and severity, and enhances ecosystem heterogeneity and habitat and species diversity; composition, density, structure, and condition of vegetation help reduce the threat of undesirable wildfires; and ecological conditions in untrammeled landscapes (such as wilderness and recommended wilderness areas) are primarily the result of natural ecological processes, which occur with little direct human influence across the larger landscape. A forestwide desired condition for animal and plant species includes course level direction to provide sustainable populations of plant and animal species supported by healthy ecosystems, ecological processes, and land stewardship activities ecosystems, which would be resilient to uncharacteristic fire, climate change, and other stressors. Alternative A has no direction specific to climate adaptation or resilience. There is some ecological restoration aimed at reducing forest density but it is more limited in intensity and extent.

Desired conditions for ecosystem type-specific plan direction for the plan revision alternatives would provide for the composition, structure, and function of vegetation that is within the natural range of variation for the ecosystem type, and is resilient to fire, drought, insects, pathogens, and climate change, and fire frequency is within the natural range of variation for the ecosystem type. For many ecosystems, fire is a key ecological process to restore and maintain proper conditions, and to increase heterogeneity and understory plant vigor. Other plan direction for some terrestrial ecosystem types under the plan revision alternatives would include design measures that benefit plant species of conservation concern. For example, restoration projects following large-scale changes in structure or species composition (like type conversion to cheatgrass) from wildfires, or other disturbances, should consider restoring habitat, including restoring connectivity, and long-term maintenance of regional biodiversity in disturbed and adjacent undisturbed landscapes. In addition, there is direction for xeric shrub/blackbrush that projects must include design measures to minimize damage to biological soil crusts, with the intent is to maintain areas resistant to nonnative plant invasions, and to include islands of untreated vegetation in project design to speed native species regeneration. Alternative A would not emphasize forest heterogeneity approaches to promote resilience to the same degree as the plan revision alternatives.

Plan direction for the plan revision alternatives would include that riparian conservation areas have ecological conditions that support aquatic and riparian-dependent plant and animal species, including plant species of conservation concern occurring in riparian systems. Direction would also: limit impacts to water quality or habitat for aquatic and riparian-dependent species, including from livestock grazing; support stable herbaceous and woody vegetative communities that are resilient to drought, climate change, and other stressors; and insure natural hydrologic, hydraulic, and geomorphic processes sustain their unique functions and biological diversity. The latter is particularly important to the 27 plant species of conservation concern that are affected by hydrologic alteration. Alternative A direction and best management practices would reduce the impacts of management actions locally but do not by themselves address the biodiversity, sustainability, or persistence of aquatic and riparian associates. Plan direction is primarily prescriptive and restrictive to limit management activities that would restore forest vegetation and improve habitats that support the persistence of all life stages of aquatic or riparian species.

Resilience of riparian composition and structural heterogeneity to climate change and increased risk of wildfires would not be improved in alternative A except on the occasional basis.

There are several plan components for the plan revision alternatives in the “Animal and Plant Species” section and other resource areas that would provide direction specific to at-risk species, providing fine filter direction that would add additional emphasis to key ecological conditions for many at-risk plant species. For example, there is a forestwide terrestrial ecosystem and vegetation desired condition reinforcing ecological conditions support the persistence of at-risk species and direction in the forestwide components for animal and plant species that ecological conditions provide habitat to improve conditions for at-risk species and support self-sustaining populations within the inherent capabilities of the plan area. Other at-risk species specific direction includes ecosystems are resilient to uncharacteristic fire, climate change, and other stressors, and this resilience supports the long-term sustainability of plant communities; that land management activities are designed to maintain or enhance self-sustaining populations of at-risk species by considering the relationship of threats and activities to species survival and reproduction; that the structure and function of vegetation, aquatic and riparian systems, and associated microclimate and smaller scale elements (carbonate rock outcrops, fens, or pumice flats) exist in adequate quantities to provide habitat and refugia for at-risk species; that there would be collaboration with other partners to maximize opportunities to improve conditions in the plan area for at-risk species; that design features, mitigation, and project timing considerations are incorporated into projects that may affect occupied habitat for at-risk species; and that habitat management objectives or goals from approved conservation strategies or agreements are incorporated, as appropriate, in the design of projects that will occur within at-risk species habitat. Alternative A would continue plant sensitive species direction to emphasize the development and implementation of a consistent, systematic, biologically sound program for sensitive plant species and their habitat so that federal listing does not occur. The plan revision alternatives include this as plan guidance in the form of a potential management approach. Plan direction for alternative A would also include inventories of project sites, a sensitive plant program management plan for the Forest, species management guides, and scientific studies where there are known detrimental effects on sensitive species.

The plan revision alternatives direction would provide for persistence of plant species of conservation concern that occur in special habitats and address identified threats to special habitats. Examples of special habitats for at-risk plants include alkali flats, pumice flats, caliche-covered clay soil mounds, and rock outcrops which may support several at-risk plant species. Principal habitats, including special habitats, for each at-risk plant species are listed in (table 70). For alternative A, there is no specific direction for special habitats with limited distribution; plant sensitive species occurring in these areas would be included in plan direction for developing species management guides.

For the plan revision alternatives, desired conditions for special habitats include maintaining or improving the composition, diversity, and structure of these habitats, including where there are multiple uses such as recreation and grazing; providing habitat and refugia for species with a specific geographic or restricted distribution; and that conditions would remain suitable for long-term sustainability of the suite of native plants adapted to special habitats and their associated insect pollinators. These are especially important for species with extremely limited distributions like *Thelypodium milleflorum* and a few other plant species of conservation concern found in caliche-covered clay mounds in eastern Mono Basin. This species faces increasing threats from invasive species, wild horse browsing, unauthorized off-highway vehicle travel, vegetation management, and climate change. Other plan direction would include working cooperatively with researchers and interested parties to study and monitor, and assist in appropriate restoration measures of special habitats; incorporate the location of special habitats in the corporate geographic information system; evaluate and incorporate maintenance and enhancement needs for special habitats into project design and implementation; and avoid fire management activities in special habitats.

The plan revision alternatives would also include plan components to alleviate or eliminate threats to species of conservation concern from activities associated with wildfire management, sustainable recreation, designated wilderness, tribal relations and uses, and other land management activities. For example, plan direction would reduce the impacts of wildfire on plant species of conservation concern through fuel reduction treatments, prescribed fire, and managing wildfires that can benefit natural resources while reducing wildfire risk. There is desired condition direction that fire occurs as a key ecological process in fire-adapted ecosystems where it does not pose an unacceptable risk to life and property, and that fire occurs within an ecologically appropriate regime of frequency, extent, and severity, and enhances ecosystem heterogeneity, and habitat and species diversity.

Overall, alternatives B, B-modified, C, and D have greater potential short-term negative effects to species of conservation concern compared to alternative A, due to the increased pace and scale of restoration, but they also have more potential for long-term positive effects due to restoration of resilience to ecosystems. Ecological restoration is expected to be focused in the mixed conifer and Jeffrey pine in the High Sierra Nevada region. The potential increased short-term effects are primarily related to the increase in mechanical treatments, which could increase soil erosion, soil compaction, or trampling of plants. These site-specific negative effects to at-risk plant habitat extent and quality would be mitigated through project design features, but mitigations may not eliminate effects altogether. Long-term landscape restoration of forested ecosystems, including restoring fire regimes within the natural range of variation, would have positive effects to at-risk plant habitat and quality, including for short-leaved hulsea (*Hulsea brevifolia*) and Father Crowley's lupine (*Lupinus padre-crowleyi*). Since there are some differences between alternatives in the amount and methods of achieving restoration, this aspect is further discussed by alternative below.

The increased vegetation management activity and increase in the restoration of fire, while beneficial overall to improve ecosystem diversity and ecosystem integrity, creates habitat for several invasive species, including cheatgrass (*Bromus tectorum*) and yellow starthistle (*Centaurea solstitialis*). At least 19 plant species of conservation concern are known to be threatened or potentially threatened by invasive species. Although the increased vegetation management activities would likely result in both short-term and long-term increases in invasive plant species, these increases would be offset to some extent by treatment actions proposed under each alternative. The plan revision alternatives include similar plan direction compared to alternative A, to guide projects to minimize the risk of invasive species spread associated with project activities and to monitor and treat infestations when they occur. The plan revision alternatives include desired conditions limiting invasive plant invasion and spread, and management approaches, standards, and guidelines to reduce invasion and spread during management activities using an early detection and rapid response strategy. The amount of invasive species treatment and eradication could be increased by the emphasis on more cooperation and collaboration with other agencies and partners, and emphasis to coordinate with research to evaluate the potential effects of climate change on the spread of invasive and nonnative species. Invasive plant species compete with native plant species, and can change the fire regime in an area, leading to negative effects to some species of conservation concern. Direction includes an objective to take action to eradicate at least three species of high priority nonnative invasive plants from the Inyo National Forest within 10 years of plan approval. Although restoring the fire regime to the natural range of variation is generally beneficial to species of conservation concern, there is no historic proxy for a fire regime under the current condition of nonnative invasive plant species infestation. Thus, it is unknown if restoring the fire regime would result in less impact to native species from invasive species. Adaptive management would be essential to ensure that the increased use of fire does not result in negative effects to species of conservation concern from the indirect effects of invasive plant species introduction and spread.

Eighteen plant species of conservation concern occur in meadows and the plan revision alternatives would increase the amount of meadow restoration compared to alternative A. Restoration efforts in meadows and other herb-dominated communities and riparian areas, would likely have positive, long-term effects for the many at-risk plant species dependent upon these systems. This would provide benefit to species dependent upon those habitats, especially those that have been negatively affected by hydrologic changes like Lemmon's milk-vetch (*Astragalus lemmonii*), which occupies moist alkaline meadows in the Long Valley area.

Climate change is a major threat of many high elevation at-risk species (45 species) that have extremely low occurrences, and climate change and the potential related drought effects will likely continue to exert pressure on the key ecological conditions that these species depend. The Inyo National Forest cannot directly control climate change, but ecosystem plan components in the plan revision alternatives would provide conditions resilient to ecosystem stressors and the interrelated effects of climate change and support the long-term sustainability of at-risk plant communities. Direction includes that fire management and reforestation is responsive and adaptable to rapidly changing conditions. And reforestation treatments are emphasized in riparian areas that face the most risk from large-scale events associated with climate change. There is also an emphasis interpretation and conservation education to convey up-to-date and clear messages about natural resources and climate change, and could include information on impacts to plant species of conservation concern. Alternative A would include direction that will somewhat reduce the impacts of climate change on plant species of conservation concern, but the rates are relatively low to moderate rates of restoration treatment compared to the plan revision alternatives.

Forestwide direction under the plan revision alternatives for sustainable recreation and wilderness include support for at-risk species. For example, forestwide direction for sustainable recreation would include desired conditions to provide a variety of recreation activities with minimal impact on sensitive environments and resources; dispersed recreation does not adversely impact natural resources; permitted recreation special events protect natural resources, and trails are compatible with other resources, like plant species of conservation concern. Other direction would include managing dispersed recreation activities when evidence of impacts to natural resources emerge; not locating new recreation facilities within at-risk plant species habitat; and to address impacts to at-risk species habitat and changing conditions in recreation settings during project design. Desired conditions and guidelines for wilderness mitigate threats from recreation, fire and livestock and ensure watersheds are functioning properly and that impacts to at-risk species are minimized. Management direction under alternative A would not include managing recreation activities with minimal adverse impacts to sensitive environments and natural resources, including at-risk plant species.

The plan revision alternatives' direction related to at-risk plants and Tribes would include that Native Americans have access to traditional and cultural practices for plant gathering and that their traditional ecological knowledge is valued in the process of developing and implementing restoration projects.

Consequences Specific to Alternative B

In addition to the short- and long-term consequences for plant species of conservation concern habitat extent and condition as described in the "Common to Alternatives B, B-modified, C, and D" section, there are some additional consequences to alternative B. The moderate restoration treatment rates of alternative B would reduce the combined impacts of climate change, fire, insects, and pathogens in more areas than in Alternative A. Treatments in sagebrush and pinyon juniper ecosystems will have enhanced capacity to resist the interactive effects of multiple stressors. Alternatives B incorporates four strategic fire management zones to better align expectations of where fire suppression may be more favored, like areas with highly valued resources and assets, or areas where fire risks are lower and there is greater potential to restore fire as an ecosystem function. Alternatives B would prioritize fuel reduction and restoration treatment in the two protection zones and on strategic ridges and along key roads; this can facilitate larger landscape prescribed burns or increase opportunities to manage wildfires when it is determined they have the potential to meet resource objectives. At least 20 percent of the landscape is anticipated to be restored through various management activities, including vegetation management, fuels reduction, and timber harvest. Alternative B would have a larger area potentially treated to reduce fire risks and restore ecosystem conditions compared to alternatives A, and alternative B encourages designing larger, landscape-scale ecological restoration projects in order to better restore ecosystem functions such as fire regimes and improving watershed conditions. There is more potential for mechanical treatments to be used for alternative B than for alternative A, which could result in more potential for the spread of invasive species. However, additional plan direction increases emphasis on mitigating and controlling invasive species when planning ground disturbing projects which may slow the spread of invasive species. Vegetation treatment rates in riparian ecosystems and meadows would also likely be higher in alternative B, resulting in potential short-term impacts from treatment and potential long-term benefits like resilience to climate change and other threats compared to alternative A. Although alternative B would map portions of the sagebrush habitats as Wildfire Restoration Zone, due to known sensitivity of sagebrush habitats to fire and invasive species following fire, most wildfires would continue to be suppressed.

Recommended wilderness areas under alternative B could serve to benefit plant species of conservation concern by precluding management activities, like mechanical treatments that might allow increases in invasive species, and by limiting mechanized and motorized activities such as mountain biking and unauthorized off-highway vehicle travel that could cause soil disturbance. The recommended wilderness in alternatives B would provide benefit to some plant species of conservation concern that occupy these areas, such as species that occupy xeric shrub and blackbrush habitats (like Charlotte's phacelia), or the special carbonate habitat type (such as Nevada ninebark).

Consequences Specific to Alternative B-modified

Alternative B-modified would strengthen some plan direction for plant species of conservation concern, for example, by elevating an "Animal and Plant Species" guideline to a standard, so that design features, mitigation, and project timing considerations are incorporated into projects that may affect occupied habitat for at-risk species.

Alternative B-modified makes some procedural changes to the plan direction regarding production livestock grazing in alternative B without making substantive changes in the range program overall from the current condition. This is not expected to directly result in any changes to the current livestock grazing program in and of itself and would not cause any immediate change in range management. Permitted livestock grazing would continue as determined by site-specific allotment management plan decisions and in accordance with annual operating instructions. Forestwide direction for at-risk species would ensure that the ecological conditions needed for at-risk species is considered when livestock grazing permits are issued.

Alternative B-modified is the only alternative that would provide direction to manage recreation settings through a zoned approach, including the use of direct management techniques in the general recreation area zone to respond when necessary to protect resources like habitat for plant species of conservation. For example, *Astragalus subvestitus* is a species that occurs in the general recreation area, and trampling by unauthorized off-highway vehicle travel has been observed as a threat to this species in the Monache Meadows area. Destination recreation areas have concentrated recreation use, and alternative B-modified includes guidance that infrastructure, maintenance, or more controls such as setting capacity limits may be needed to protect resources.

Alternative B-modified replaces many smaller critical aquatic refuges with a few larger conservation watersheds. Critical aquatic refuges in the other alternatives are largely delineated around aquatic wildlife species and it is largely unknown to what extent they also provide habitat for plant species of conservation concern. However, conservation watersheds, because of the large subwatershed scales, did consider the location of plant species of conservation concern in identifying which watersheds should be selected. Because most conservation watersheds are large and are focused on high elevation headwaters watersheds, they include many locations of species associated with alpine, subalpine, and meadow ecosystem types. However, since many of these same occurrences are in designated wilderness areas, there is little additional species specific benefit from being in conservation watersheds. Some of the species in the lower elevation portions of the Mono Lake Headwaters and Cottonwood-Crooked Creek Headwaters conservation watersheds may include species using other ecosystem types. In all cases, the forestwide direction for at-risk species provides the primary project level guidance that would ensure that projects are designed to provide for the persistence of plant species of conservation concern. Therefore, while it is known that several plant species of conservation concern occur in the conservation watersheds and several could also occur in some of the critical aquatic refuges of the other alternatives, it is not likely there is a substantial difference in risk or benefit to these species between alternatives because of this forestwide direction for at-risk species in alternatives B, B-modified, C, and D, and the direction to evaluate project level effects to sensitive species in alternative A.

Alternative B-modified makes some changes in the locations of the alternative B strategic fire management zones, primarily to adjust areas dominated by the sagebrush vegetation types to be reclassified from wildfire restoration zone or wildfire maintenance zone to the general wildfire protection zone. This recognizes that sagebrush ecosystem are sensitive to fire with invasive species such as cheatgrass often significantly type converting and degrading burned areas. The classification of general wildfire protection zone indicates that most wildfires will likely have some fire suppression actions taken. While there could be some additional ground disturbance from fire suppression actions, much as currently occurs, extra efforts are taken during fire incident management and in post-fire restoration to reduce the risk of invasive species spread. Since the sensitivity of sagebrush ecosystems to wildfire is known, it is likely that would be little functional difference between the plan revision alternatives in terms of where and when wildfires would have suppression actions taken since in all alternatives fire management decisions consider factors such as safety, impacts to resources and assets, and overall manageability of the fire. However, the overall intent to manage sagebrush ecosystems through restoration actions other than increasing the amount of fire restored to the landscape is clearer in alternative B-modified than the other alternatives. This would potentially benefit the 44 plant species of conservation concern associated with the sagebrush ecosystem.

Effects to plant species of conservation concern for recommended wilderness areas under alternative B-modified are the same as alternative B.

Consequences Specific to Alternative C

Due to less intensive vegetation management favoring prescribed burning and minimizing mechanical treatments, alternative C would likely have the fewest short-term negative effects to plant species of conservation concern, particularly those dependent on mixed conifer and Jeffrey pine ecosystems. Acres with mechanical treatment under alternative C would be one-quarter of the current plan; this is the fewest acres of mechanical treatment of all alternatives. To the extent that mechanical ground disturbance increases the risk of invasive species spread, risk of new invasive plant species infestations and spread and negative effects on plant species of conservation habitat would likely be less than other alternatives. However, alternative C would have a larger focus on restoration of sagebrush and pinyon-juniper ecosystems, with much of the work completed with mechanical or hand work to remove conifers. So there is a risk of increased spread in these areas. It would still be likely that alternative C results in the fewest negative effects to plant species of conservation concern habitat quality of all alternatives. Recreation site improvements are likely to be less under this alternative compared to alternatives B, B-modified, and D, resulting in few impacts to habitat; however, a continuation of existing recreation impacts would likely continue under C.

The greater area of recommended wilderness under alternative C may provide benefit to some plant species of conservation concern that occupy these areas, such as species that occupy xeric shrub and blackbrush habitats or the special carbonate habitat type, or populations of Raven's milk-vetch in the Glass Mountains, which have been impacted by unauthorized off-highway vehicle travel (assuming enforcement and signage aimed at preventing unauthorized motorized vehicle travel would be increased because of the recommended wilderness status). However, the recommended wilderness status would allow some non-conforming activities including mechanized restoration of the sagebrush in the Glass Mountains, although it might be more limited than in the other alternatives.

Consequences Specific to Alternative D

Alternative D proposes more intensive vegetation management, especially within the mixed conifer and Jeffrey pine ecosystems. The potential timber harvest activity for alternative D is estimated to be the greatest of all alternatives due to greater flexibility in achieving desired conditions and encouragement of larger, landscape-level projects. Although these activities result in a higher risk for new invasive plant species infestations, through the disturbance of soils and removal of vegetation cover, the absolute level of harvest activities is still low, significantly less than historic levels, and methods and equipment used have less ground-disturbing impact.

Restoration activities would strive to maintain native species composition and by inference, exclude or control nonnative species.

Project design features would minimize invasive plant species introduction and spread, but the risk of invasions as the result of soil disturbance and loss of vegetation cover would be greater than under the other alternatives because the risk of introductions cannot be eliminated altogether. The section above on “Consequences Common to Alternatives B, B-modified, C, and D” provides an overview of potential negative and positive effects of both vegetation management to species of conservation concern. The 11 species identified in table 70 as potentially threatened by fuels treatment and the 51 species potentially affected by recreational activities, may have greater short-term negative effects to habitat extent and condition under this alternative.

However, the greater acreage of restoration proposed under this alternative would benefit some species, especially those that are threatened by altered fire regimes, such as short-leaved hulsea, Father Crowley's lupine, and narrow-leaved cottonwood.

Cumulative Effects

At-risk plant species are affected by management activities that occur both within the plan area and on adjacent land under Federal, State, local agency, or private management. The consequences of these actions are cumulative across boundaries. These cumulative actions could produce positive results, such as increased at-risk plant habitat extent or improved condition as restoration measures are taken, particularly those that reduce the risk or extent of invasive species. Similarly, there may be negative impacts, such as habitat loss, or degradation, primarily by the introduction or spread of invasive plant species.

Many restoration activities and project design features aimed at protecting at-risk species are shared by adjacent public land agencies, in particular the National Park Service and Bureau of Land Management. For example, efforts to use weed free and weed seed-free plant material for animal feed or bedding, soil stabilization and land rehabilitation complements similar efforts in the adjacent Yosemite and Sequoia and Kings Canyon National Parks. Combined and coordinated efforts in these areas would improve ecological conditions that provide for the persistence of at-risk species. Similarly, fire management strategies and approaches are similar across the federal land management agencies and interagency coordination occurs with federal, state, and local agencies and Tribes when wildfires cross or threaten adjacent lands. Similar approaches to restore fire to wilderness areas and remote areas are likely to result in more acres where wildfires are managed to meet resource objectives in the future on federal lands which would benefit species in the long run by restoring fire regimes similar to the natural range of variation.

Other reasonably foreseeable vegetation management activities that may occur on private, State, or other Federal land would be similar in effects to those performed on the national forest—prescribed burning to restore fire disturbance regimes or the thinning or removal trees to reduce the risk of high-severity wildfire. These activities would be expected to have similar short-term impacts and long-term benefits similar to those described above, although activities on private lands would have less emphasis or protection for species that do not have state or federal designations such as state or federal endangered species status or state species of concern status.

Road management will continue to occur on state and county roads and roads will remain as potential sources of invasive plants. Vehicles traveling on roads with invasive species or that have been used off-road on other lands with invasive species could spread those invasive species onto the national forest. The plan revision alternatives include direction described above to work with other partners such as the counties to address invasive species which could reduce the extent and risk of invasive species spread or coordinated treatment that is more effective and efficient. This would benefit at-risk plant species overall.

Analytical Conclusions

Candidate Plant Species Determination

Key conclusions:

- The forest plan provides a programmatic framework for future site-specific projects and actions but does not prescribe specific projects or assign project locations. Plan components exist to ensure proposed actions avoid, mitigate or minimize impacts to candidate species. All future project level activities that may affect this species will require project-specific assessments to evaluate the extent that projects may accelerate the trend toward federal listing and projects may seek technical assistance from the U.S. Fish and Wildlife Service on additional conservation recommendations to consider or incorporate to avoid, minimize, or mitigate potential effects.
- All alternatives recognize the need to develop a regional whitebark pine conservation and restoration strategy relevant to whitebark pine in California national forests which could identify additional actions to better conserve the species on the Inyo National Forest.

For whitebark pine, we determined that despite plan components and plan content that would serve to avoid, mitigate, or minimize effects, some actions and activities may disturb or remove individuals and whitebark pine stands or habitat could be affected by restoration activities and management actions along roads and near facilities. Since the forest plan is at a programmatic level, it cannot ensure that projects developed under it would have no effect or that all actions would be discountable, insignificant or beneficial. Therefore, we determined that adoption of the revised forest plan under all alternatives *may affect individuals, but is not likely to jeopardize the continued existence* of the whitebark pine on the Inyo National Forest.

For the purpose of revising the forest plan, we determined that all plan revision alternatives have developed adequate plan components (ecosystem and species-specific) to provide for ecological conditions that contribute to the conservation of whitebark pine within the plan area.

Plant Species of Conservation Concern Determinations and Plan Evaluation Outcomes

In general, alternative A would provide the necessary ecological conditions to maintain viable populations of at-risk plant species by relying primarily on project-level surveys and mitigations of adverse effects for Regional Forester sensitive species. Although there are 59 plant species of conservation concern that are not Regional Forester's sensitive species, in general they occur in similar habitats and ecological conditions are expected to be provided. However, since alternative A would likely result in lower restoration treatment rates than other alternatives, vegetation would likely remain dissimilar to the desired condition in structure, composition and resilience across many arid landscapes.

The Inyo National Forest has 105 botanical species of conservation concern. Many of these species have very low number of occurrences and/or very limited distribution, however, the relative rarity of a species alone does not constitute vulnerability. In analyzing persistence of plant species of conservation concern, rarity is a factor that is included along with ecological conditions of habitat and the identified threats in the plan area. Because botanical species are non-mobile, identified threats to species with very low numbers of occurrences and/or very limited distribution need to be managed at sites where they exist in order to improve resilience to stochastic events (such as wildfire, flooding, and climate change) and provide for persistence over the long term.

During the persistence analysis of plant species of conservation concern for the plan revision alternatives, each species was evaluated individually (see appendix F in volume 2) and grouped into one of these three determinations:

- For species having one or two occurrences in the plan area, with identified threats to persistence, and the species also occurs elsewhere: *It is beyond the authority of the Forest Service or not within the inherent capability of the plan area to maintain or restore the ecological conditions to maintain a viable population of these botanical species in the plan area. Nonetheless, the plan components should maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range.* There are twenty-two plant species of conservation concern in this group.
- For species that have low to very low numbers of occurrences, limited distribution, and identified threats to persistence in the plan area (although some species are endemic to the plan area, many occur elsewhere but have more than two occurrences in the plan area): *The ecosystem plan components may not provide the ecological conditions necessary to maintain a viable population of these botanical species of conservation concern in the plan area. Therefore, additional species-specific plan components have been provided. The combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain a viable population of these botanical species in the plan area.* There are seventy-three plant species of conservation concern in this group.
- For species that have sufficient numbers and distribution of occurrences, and individuals within occurrences, such that inadvertent loss of individuals or occurrences will not threaten population persistence and viability: *The ecosystem plan components should provide the ecological conditions necessary to maintain a viable population of these species of conservation concern in the plan area. Nonetheless, additional species-specific plan components have been provided for added clarity and/or measures of protection.* There are 10 plant species of conservation concern in this group.

All three determinations provide both ecosystem and at-risk species-specific forest plan direction for persistence. The outcome for each plant species of conservation concern is displayed in appendix F. The emerging plan components under alternatives B, B-modified, C, and D when carried out, would provide the necessary ecological conditions to maintain viable populations of plant species of conservation concern. These alternatives include ecosystem coarse filter plan components aimed at protecting the broad habitats upon which these species depend and at-risk species-specific and ecosystem type-specific plan components, especially those for special habitats, to ensure species persistence.

To the extent possible, the broad ecosystem desired conditions provide for the broad ecosystem fabric that supports sufficient distribution of a minimum number of reproductive individuals of species of conservation concern and their habitat so that species would remain viable. Species distribution is partially provided for by plan components that aim to maintain or restore the diversity and connectivity of ecosystems and habitat types throughout the plan area (FSH 1909.12.20.13). Forest-wide ecosystem plan components support natural ecological processes, functions, and biodiversity, and promote ecological conditions that are resilient to climate change and other stressors. Additional ecosystem plan components provide area-specific desired conditions and management direction, and are tailored to specific ecosystem types or management areas, including providing ecological conditions that support persistence of species of conservation concern in riparian conservation areas; habitat types that host many botanical species of conservation concern. Forestwide plan direction includes the intent to protect habitats as the ecological fabric to maintain persistence of a large group of at-risk plant species, and it is expected that alternatives B, B-modified, C, and D would have minimal short-term negative effects to habitat extent and quality for those at-risk species that depend on them. Disturbance processes (such as fire) and management activities (such as grazing and recreation) are addressed by ecosystem and other plan components that consider effects to plant communities and/or species diversity.

At-risk species-specific plan components provide additional forest-wide guidance for at-risk species: to promote healthy, resilient ecosystems that support functional plant and animal communities and self-sustaining populations of at-risk species. These plan components are particularly important to botanical species of conservation concern because they address site-specific threats in occupied habitat. Species-specific plan components, including for special habitats, mitigate risk to persistence from land management activities, and provide guidance for addressing existing site-specific threats not related to project activities, while balancing the needs of at-risk species with other resource uses and ecological processes. In addition, at-risk species-specific potential management approaches suggest development of systematic and programmatic approaches to achieve conservation of these botanical species.

When necessary, project-level protections are an option. As a result, each threat in each ecosystem for each species of conservation concern identified has been addressed or mitigated in at least one plan component in the forest plan, to provide for the persistence of each species.

For the purpose of revising the forest plan, we determined that all plan revision alternatives have developed adequate plan components (ecosystem and at-risk species-specific) to provide for ecological conditions that contribute to the persistence of plant species of conservation concern in the plan area, or, for those species described above and in appendix F, contribute to maintaining a viable population of the species within its range.

Revision Topic 3:
Sustainable Recreation and Designated Areas

The following section provides the analysis for recreation and scenery, heritage, wilderness, wild and scenic rivers, and the Pacific Crest National Scenic Trail. Wilderness and the Pacific Crest National Scenic Trail are discussed with the recreation and scenery resource because of their key roles within the larger context of sustainable recreation. Maps showing the recreation opportunity spectrum, recreation places and scenic integrity objectives are located in appendix A of the draft forest plans.

Sustainable Recreation and Scenery

Sustainable Recreation

The need to provide sustainable recreation was a key topic of interest at public meetings and during public engagement. Sustainable recreation is the recreation settings and opportunities on National Forest System lands that are ecologically, economically, and socially sustainable for present and future generations.

Analysis and Methods

Indicators and Measures

- Percentage of recreation opportunity spectrum class by alternative
- Change in miles of system trails that allow mechanized transport within areas recommended as wilderness
- Change in miles of motorized routes within areas recommended as wilderness or Eligible Wild and Scenic Rivers
- Effectively manages recreation development to respond to recreation demand and uses

Methods

The recreational opportunity spectrum is the Forest Service's method of defining recreation settings. These settings are categorized into six classes: primitive, semi-primitive nonmotorized, semi primitive motorized, roaded natural, rural and urban. The level of development in roads and facilities is directly tied to these settings. The amount of land in each of the classes indicates the expected level of development, type of settings, and access that can be expected. Providing a range of settings that vary in level of development, access insures recreation al experiences for a wide range of activities.

The Inyo niche is an important aspect in characterizing the existing condition and assessing the approaches to recreation management in the alternatives. The Inyo's niche statement developed during the 2007 recreational facilities analysis process describes a forest that attracts visitors from all parts of the state, country and world to enjoy and experience the stunning scenery and high quality diversity of recreation. Iconic destinations such as Mt. Whitney, Mono Lake and the Ancient Bristle cone Pine forest, as well as outstanding designated wilderness characterize this forest.

Types of recreation activities visitors participate in are measured through the National Visitor Use Monitoring program in the Forest Service which provides a consistent national approach to data collection. Under the National Visitor Use Monitoring program, national forests conduct studies every 5 years, and each national forest monitors visitor use through exit surveys. The program provides science-based estimates of the volume and characteristics of recreation visitation to national forests. The Inyo National Forest last collected data in 2016; however the most recent years for which study results are available are 2006 and 2011. Results from those recent surveys are discussed in more detail in the "Visitor Use" section.

Assumptions

In the analysis for this resource, we made the following assumptions:

- Partnerships and volunteer opportunities are viable options to maintain and possibly increase forest capacity. However, attempts to increase partnerships beyond certain levels may be constrained by agency capacity.
- Conservation education and interpretative services can play a key role in fostering a greater connection between people and nature and helping to create an understanding of sense of place.
- Recreation demand is increasing across Inyo National Forest.
- Deferred maintenance on developed recreation sites and infrastructure is continuing to outpace budgets.
- Funding and agency recreation staffing are anticipated to decline throughout the planning cycle.
- Effective interpretive techniques and public information services can help to inform and motivate the public into becoming stewards of the national forest (California Outdoor Recreation Planning Program 2002, National Association of Recreation Resource Planners 2009).
- Climate change is predicted to produce warmer temperatures and drier conditions influencing snowpack, drought, and hydrologic flow. Activities dependent on snow and snow melt would be affected. Warmer temperatures could cause recreationists to shift their activities to higher elevations during the summer months (Morris and Walls 2009).

Affected Environment

Background

Outdoor recreation contributes to human health and well-being by offering a variety of physical and mental health benefits. Eighty-four percent of the Californians polled in the most recent Comprehensive Outdoor Recreation Plan statewide survey said outdoor recreation was an "important" or "very important" contributor to their quality of life (Roberts et al. 2009).

Areas adjacent and within the national forest boundaries are projected to continue to increase in population. This growth is expected to increase recreation demand in these national forests, and increase the numbers of visitors in the future (English, Froemke, and Hawkos 2014). With projected growth, increase in use levels can potentially increase conflicts, such as crowding, which can lead to unmet visitor expectations for recreation experiences and can influence public satisfaction at recreation sites.

In addition to growth, increases in culturally diverse populations will likely be reflected in outdoor recreation (Winter et al. 2014). Two groups whose growth is expected to have the most influence on outdoor recreational styles and participation patterns in the future are Latinos and Asian Americans (Roberts et al. 2009). Current recreation infrastructure may not meet the needs of these two groups which include larger developed group sites with picnic tables, grills, trash cans and flush toilets picnicking that support day-long activities, hiking and walking, and opportunity to be with family (Roberts et al. 2009).

Increase in recreational use, particularly unmanaged recreation, impacts ecosystems by causing changes in habitat through vegetation trampling as well as the spread of noxious or invasive plant species to new locations. Unmanaged recreation can include areas that are difficult to manage, areas where inappropriate dispersed recreation is occurring or areas that have unmonitored nontraditional recreation activities (Pond 2007). Impacts from unmanaged recreation are often found in riparian areas, areas adjacent to the urban interface, areas of intense recreation use, and areas just outside of developed recreation sites. Examples of unmanaged recreation include user-created trails to access rock climbing routes at newly discovered climbing areas, user-created mountain bike trails, dispersed camping in sensitive ecosystems such as riparian areas, and motorized vehicle use outside of designated travel routes. Unmanaged recreation can also adversely affect visitor experiences as a result of conflicting or competing uses and overcrowding. Ecosystem impacts may ultimately have a negative effect on recreation if the impacts create conditions where recreation use can no longer be supported.

To ensure sustainable recreation on the Inyo National Forest, adaptive management will be necessary. This is particularly true for unmanaged recreation, where timely response to new uses that have potential ecological effects will be necessary. Given the expected increase in population and recreation demand, tradeoffs will need to be made to ensure that resources are managed sustainably.

People choose a specific setting for recreation activities to achieve a desired set of experiences. For example, camping in a large undeveloped area with few facilities offers a sense of solitude, challenge, and self-reliance. In contrast, camping in a setting having easy access and developed facilities such as restrooms and tables offers more comfort, convenience, security, and opportunities for social interaction. The Inyo National Forest provides opportunities for recreationists to obtain satisfying recreation experiences through choices in both the types of settings and use (levels and types of use), and conditions provided by management (developments, roads, regulations).

Recreation Settings and Opportunities

Recreation opportunities are the opportunities to participate in a specific activity in a particular recreation setting to enjoy a desired recreation experience. Recreation settings allow a range of experiences to be achieved, from remote and challenging to easily navigated and supported by tourism services in surrounding communities. The “recreation opportunity spectrum” offers a framework for understanding these settings and experiences. It is aligned with scenic character and scenery settings that support the value of recreation opportunities and the ability to connect people with nature.

The recreation opportunity spectrum has six distinct classes in a continuum to describe settings that range from highly modified and developed to primitive and undeveloped (Clark and Stankey 1979). The six classes are described below.

- **Primitive** (P) – An unmodified natural environment with very high probability of experiencing solitude. Motorized use within the area is generally not permitted.

- **Semi-primitive nonmotorized** (SPNM) – A predominantly natural or natural-appearing environment with high probability of experiencing solitude. Motorized use is generally not permitted.
- **Semi-primitive motorized** (SPM) – A predominantly natural or natural-appearing environment with moderate probability of experiencing solitude. Motorized use is generally permitted.
- **Roaded natural** (RN) – A predominantly natural-appearing environment with moderate evidence of the sights and sounds of other humans. Motorized use is provided for in construction standards and design of facilities.
    - ♦ **Roaded modified** (subclass of roaded natural) – A substantially modified natural environment except for campsites. Motorized use is provided for in construction standards and design of facilities.
- **Rural (R)** – A substantially modified natural environment. Sights and sounds of people are readily evident, and the interaction between users is often moderate to high.
- **Urban (U)** – A substantially urbanized environment, although the background may have natural-appearing elements. Sights and sounds of people onsite are predominant. Large numbers of users can be expected, both onsite and in nearby areas.

The existing recreation opportunity spectrum map (volume 3) was updated to correct for unintended data errors from data migration and technology improvements over time, and to reflect changes adopted by forest plan amendments that had not yet been updated in the recreation opportunity spectrum data system.

Table 72 shows the allocation of the existing recreation opportunity spectrum classes on the Inyo National Forest. The largest four recreation opportunity spectrum classes are primitive (53 percent), roaded natural (15 percent), semi-primitive motorized (14 percent), and semi-primitive nonmotorized (12 percent). The nonmotorized setting accounts for 65 percent of the national forest; this is primarily due to designated wilderness areas (46 percent of the national forest) and large amounts of inventoried roadless areas (836,583 acres). The motorized setting occurs on 31 percent of the national forest.

Table 72. Existing recreation opportunity spectrum classes

Recreation Opportunity Spectrum Class	Acres	Percent Total Acres
Primitive	1,061,318	53
Semi-primitive nonmotorized	241,504	12
Semi-primitive motorized	286,784	14
Roaded natural	291,980	15
Roaded modified	49,011	2
Rural	13,853	1
Urban	0	0
No assigned class	41,342	2

Some lands were transferred to the Inyo National Forest after the release of the forest plan in 1988 as a result of the National Forest and Public Lands of Nevada Enhancement Act, and a decision was made to wait until the next round of planning to do recreation opportunity spectrum mapping. Those areas are shown as “not assigned.”

The primitive recreation opportunity spectrum setting on the Inyo National Forest provides large, remote, and predominately unmodified landscapes where there is no motorized activity while providing for solitude with few facilities or developments. Most of these primitive settings are in wilderness areas. Semi-primitive nonmotorized recreation opportunity spectrum settings include areas of the Inyo managed for nonmotorized use although mountain bikes and other mechanized equipment can be present. Rustic facilities (like wooden bridges over wet areas) are present for the primary purpose of protecting the natural resources of the area. Semi-primitive nonmotorized settings offer opportunities for exploration, challenge, and self-reliance.

Sixteen percent of the Inyo National Forest consists of semi-primitive motorized recreation opportunity spectrum settings, which are managed for backcountry motorized use on designated routes. Routes are designed for off-highway vehicles and other high-clearance vehicles. This setting offers visitors motorized opportunities for exploration, challenge, and self-reliance. Mountain bikes and other mechanized equipment are also sometimes present. Rustic facilities are present for the primary purpose of protecting the natural resources of the area or providing portals to adjacent areas of primitive, or semi-primitive, nonmotorized areas.

The roaded natural setting, on 16 percent of the Inyo National Forest, is managed as natural appearing with corridors and destinations that support developments and concentrated use, user comfort, and social interaction. Corridors include roads such as the Ancient Bristlecone Scenic Byway, Horseshoe Meadow road, and Eureka Valley road. Destinations can include trailheads such as Bloody Canyon, Pine Creek, or Baxter Pass or campgrounds such as Hartley Springs or Inyo Craters. The road system is generally well defined in this setting and can typically accommodate sedan travel. National Forest System roads also provide access to other recreation opportunity spectrum settings of semi-primitive motorized, semi-primitive nonmotorized and primitive areas.

The smallest recreation opportunity spectrum setting on the Inyo is rural (1 percent). The rural setting represents the most developed recreation sites and modified natural settings. Facilities like picnic areas and campgrounds are designed primarily for user comfort and convenience. The rural setting is characterized by a substantially developed environment although the background may have natural appealing elements. There is no urban recreation opportunity setting on the Inyo National Forest.

Access

Recreation access consists of trails, roads, and other transportation that connect people to recreation settings and opportunities. Recreation access to and within the Inyo National Forest is provided by state highways, county roads, and a designated system of National Forest System roads and trails. Roads and trails not only provide access to recreation opportunities, but are themselves a recreation experience as driving for pleasure increases in popularity. Access to the Inyo National Forest is also provided by partners, agencies that manage adjoining public lands, and private land owners.

The transportation system on the Inyo National Forest has evolved over time, with many roads and motorized trails beginning as user-created wagon roads from the California gold rush period of the mid-to-late 1800s. As the use of roads expanded and modes of transportation changed, many of the user-created roads were reconstructed to higher standards. Routes which were created for the sole purpose of permitted resource extraction, such as mining or timber roads, were considered "temporary" roads, which would be unneeded after the permitted use ceased. Accordingly, these were generally not added to the Forest Transportation System. Increasing and unmanaged off-highway vehicle usage in the past few decades also led to significantly more user-created routes that were not part of the official Inyo National Forest transportation system.

The 2009 Inyo National Forest Motorized Travel Management Environmental Impact Statement (USDA Forest Service 2009b) analyzed the temporary and user-created routes in existence that were not part of the Forest Transportation System and considered non-system routes. The analysis considered the contribution of the routes to the administration and use of the Forest and their respective environmental concerns. The Record of Decision added over 800 miles of maintenance level 2 roads and approximately 157 miles of motorized trails to the Forest Transportation System while closing others to motorized vehicle use (USDA Forest Service 2009b).

The transportation system on the Inyo National Forest is very important to the public and tourism in the Eastern Sierra's as it is the primary means for access to the national forest. The public uses the transportation system to access recreation interests such as camping, picnicking, fishing, hunting, hiking, backpacking, mountain biking, rock climbing, sight-seeing, skiing and snowboarding, snowmobiling, driving off highway with off-highway vehicles, and visiting historic and natural interest areas. The transportation system is also used by the public for personal and commercial fuel wood gathering, mining, geothermal exploration, range uses, pine nut gathering, and traditional Native American uses. In addition to facilitating the above uses, the transportation system is also used in an administrative capacity by Forest Service staff for fire suppression, fuels management, and forest health management.

The Inyo National Forest provides motorized access through conventional two-wheel-drive roads, four-wheel-drive roads, motorized trails, and over-snow travel routes. Roads referred to as "maintenance level 1" are closed to motorized use and are maintained in storage and for future access needs. Maintenance level 2 roads are managed to accommodate travel by off-highway and high-clearance vehicles. Maintenance level 3, 4 and 5 roads are managed to accommodate passenger cars and other licensed vehicles (these are closed to unlicensed off-highway vehicles, unless specifically designated). The Inyo National Forest has approximately 1,950 miles of national forest transportation system roads (see table 73).

Table 73. Miles of system roads by maintenance level

System Roads by Maintenance Level	Miles
Roads designated for passenger cars (maintenance level 3, 4 & 5)	119
Roads designated for high clearance & four-wheel drive vehicles (maintenance level 2)	1,824
Total roads open to motor vehicles (maintenance level 2-5)	1,950

The Inyo National Forest presently offers many miles of trails for nonmotorized access. Out of the 1,669 miles of designated trails on the Inyo, 1,105 miles are standard nonmotorized trails, and 32 miles are nonmotorized snow trails. The Inyo National Forest currently manages an average of approximately 969 miles of trails per year, to a level where their maintenance and condition meet Forest Service standards. Nonmotorized trails are open to nonmotorized uses including mechanized transport outside of wilderness unless otherwise closed by a Forest Service closure order. Mountain bikes are allowed on 573 miles of trails. There are 339 miles of motorized trails, and 221 miles of trails designated as motorized snow trails open to over-snow vehicles (see table 74).

Table 74. Miles of trails by designated and allowed uses

Trails by Designated and Allowed Uses	Miles
Trails designated as nonmotorized	1,105
Trails designated as nonmotorized snow trails	32
Trails open to mountain bike use	573
Trails designated as motorized trails	339
Trails designated as motorized snow trails	221
Total # miles of trails	1,669

In this analysis, the term "mechanized transport" is defined as transport powered by a living or non-living power source and includes such things as bicycles and game carts. The term bicycle is used to represent mechanized transport in the discussion below. Bicycle use is allowed on designated motorized trails in addition to designated nonmotorized trails except within wilderness areas as described below. The Pacific Crest National Scenic Trail is closed by a regional closure order to mechanized transport. Electric bicycles are considered motorized vehicles and are allowed on designated motorized routes. Seventy-five percent of the system trails on the Inyo National Forest are located in designated wilderness. The Wilderness Act prohibits motorized use and mechanized transport such as mountain bikes, are not allowed, only primitive means of travel is permitted, such as hiking, horseback, ski mountaineering or snowshoeing; The remaining 25 percent of the trails offer a wider variety of nonmotorized travel options, such as mountain biking, and bicycling or roller blading on paved paths. Approximately 33 percent of the snow trails are groomed by permit holders as an authorized special use. All of the nonmotorized system snow trails are located outside of wilderness, and have a variety of nonmotorized activities, including Nordic skiing, snowshoeing, or walking. Nonmotorized use such as Nordic skiing or backcountry skiing is acceptable in designated wilderness.

The Inyo National Forest is open to motorized and nonmotorized winter recreation activities. Over-snow vehicles are allowed on routes and open areas outside of designated wilderness. Existing over-snow-vehicle use is not suitable in recommended wilderness areas. After site-specific analysis through subpart C of the Travel Management Rule is completed, over-snow motorized use would be prohibited by future Forest Service orders inside recommended wilderness areas. These open areas and routes are or will be shown on over-snow vehicle use maps as winter travel management analyses are completed in the future. Designated winter routes can be groomed, and open areas, which are not groomed, consist of natural snowpack that ranges from powder to spring freeze conditions.

The Inyo National Forest system of authorized motorized routes was designated in 2009 under Travel Management Planning - Travel Management Rule (36 CFR Part 212, Subpart B). There are a total of 339 miles of motorized trails open to motorized travel on the national forest in addition to 1,950 miles of National Forest System roads open to motorized travel. Management of motorized routes would remain the same between all the alternatives since the number of motorized routes does not change between alternatives.

Facilities and Level of Development

Developed recreation sites provide much of the infrastructure necessary for the enjoyment of a wide variety of recreation activities in the analysis area. The current level of development of a recreation facility depends upon the assigned recreation opportunity spectrum class and the need for managing recreation uses.

The Inyo National Forest has a total of 247 developed recreation sites, the majority of which are found in the roaded modified and rural recreation opportunity spectrum classes. They include recreation sites such as campgrounds, group camping areas, horse camps, picnic or day use areas, boating sites, and swimming sites which provide recreation opportunities and access. Table 75 identifies the number of developed recreation sites that are development scale 2 or higher on the national forest by site type. Development scales are used to define the level of development at a recreation site from minimum site modifications, which would typically exist in primitive recreation opportunity spectrum settings (Development scale 1) to a high degree of site modification, which would typically exist in rural recreation opportunity spectrum settings (Development scale 5).

Table 75. Developed recreation sites

Developed Recreation Site Type	Total Sites
Boating Site	9
Campground	79
Horse Camp	2
Campground Group	16
Interpretive Site	15
Information Site	5
Observation Site	14
Picnic Site	20
Ski Area Nordic	1
Alpine Ski Area	2
Visitor Center	5
Swimming Site	1
Trailhead	78
Total number of recreation sites	**247**

Recreation sites, and facilities within those sites require operations and maintenance. The deferred maintenance backlog in 2013 for recreation site buildings as reported in the Forest Service database of record for recreation sites (INFRA) was $3.7 million. Due to lack of staff to regularly perform condition surveys of these buildings, the actual deferred maintenance cost is likely much higher. Additionally, this figure does not include deferred maintenance of recreational water systems or wastewater systems as no data exists. Deferred maintenance for other recreation site amenities, such as campsites, food storage lockers, and picnic tables, is $3.2 million as reported in INFRA.

The majority of the campgrounds on the Inyo National Forest are run by concessionaires under special use permit. The permits are awarded on a competitive basis for a period of 5 years, with an option to extend for an additional 5 years based on satisfactory performance. The Forest

Service has Granger-Thye authority under these special use permits, which allows a fee offset to occur, where the permittee returns a percentage of their proceeds back to the Federal Government for the purpose of maintaining the recreation sites under that permit. This fee-offset helps to address deferred maintenance needs at recreation sites.

There are also privately owned recreation sites and facilities on the Inyo National Forest operated under special use permit. These privately-owned developed recreation facilities such as ski areas and resorts provide recreation opportunities and access on National Forest System lands.

Visitor Use

The Inyo National Forest offers a full suite of outdoor recreation activities, in all seasons, for those who enjoy either motorized or nonmotorized pursuits on land, water, or in the air. The list of recreation activities is long, and includes activities such as, but not limited to: cross-country and downhill skiing or snowboarding, snowmobiling, rock or ice climbing and mountaineering, hiking or backpacking, equestrian riding or packing, mountain biking, camping, hunting or fishing, off-highway vehicle driving or riding, picnicking, swimming, boating, paddle boarding, hang-gliding, wildlife watching, fall foliage viewing, visiting historic sites or scenic areas, participating in interpretive programs or tours, resort use, and more.

Despite differences in recreation preferences across demographic groups and changes that have occurred over time, the core set of activities preferred by the majority of people have generally been nonmotorized activities like walking, picnicking, swimming, riding bicycles, and viewing and learning about nature. These activities are some of the easiest and least expensive to provide and address the needs of a broad group of people (Watts Jr and Fisher 2010).

The National Visitor Use Monitoring program monitors recreation use every five years through exit surveys on national forests. The data collected during National Visitor Use Monitoring surveys provides estimates of the volume and characteristics of recreation visitation. The Inyo National Forest last collected data in 2016; however, the most recent years for which data results are available are 2006 and 2011.

Nonmotorized activities such as hiking/walking and skiing are popular on the Inyo NF, and have maintained some of the highest participation rates according to most recent NVUM surveys (NVUM 2011). Motorized activities and use of motor vehicles to travel to and engage in nonmotorized activities are also important and are discussed in the context of access below.

Table 76 lists visitor participation on the Inyo National Forest by recreation activity during 2011 National Visitor Use Monitoring surveys. Visitor participation is listed in the table by main activity and by activity participation. Because most national forest visitors participate in several recreation activities during each visit, it is more than likely that other visitors also participated in this activity, but did not identify it as their main activity. For example, on one national forest 63 percent of visitors identified viewing wildlife as a recreational activity that they participated in during this visit, however only 3 percent identified that activity as their main recreational activity (NVUM 2011).

Table 76. Visitor participation in recreation activities on the Inyo NF in 2011 National Visitor Use Monitoring surveys

Activity	Percentage Participation*	Percentage Main Activity**
Viewing Natural Features	59.2	21.2
Relaxing	54.6	6.2
Hiking / Walking	43.8	12.6
Downhill Skiing	39.4	38.1
Viewing Wildlife	34.5	2.0
Driving for Pleasure	29.0	1.8
Nature Center Activities	21.8	0.3
Picnicking	18.8	0.3
Developed Camping	14.7	2.1
Resort Use	14.7	0.0
Fishing	14.6	6.2
Visiting Historic Sites	14.1	10.2
Nature Study	11.0	0.2
Other Non-motorized	6.8	0.4
Cross-country Skiing	6.7	1.9
Bicycling	6.6	1.4
No Activity Reported	3.8	3.9
Gathering Forest Products	3.8	0.0
Primitive Camping	3.5	0.0
Non-motorized Water	2.7	0.9
Backpacking	24	1.2
OHV Use	2.2	0.0
Motorized Water Activities	1.6	0.0
Some Other Activity	1.3	0.1
Motorized Trail Activity	1.2	0.2
Snowmobiling	1.1	0.1
Horseback Riding	0.9	0.1
Other Motorized Activity	0.9	0.0
Hunting	0.2	0.0

* Survey respondents could select multiple activities so this column may total more than 100%.

**Survey respondents were asked to select just one of their activities as their main reason for the national forest visit. Some respondents selected more than one, so this column may total more than 100%.

According to 2006 and 2011 National Visitor Use Monitoring data results, the top 10 most popular activities in terms of visitor participation on the Inyo National Forest stayed relatively constant between 2006 and 2011, though rankings have changed over time. The most frequently reported primary activity in the 2011 survey was downhill skiing (38 percent), followed by viewing natural features (21 percent), and hiking (13 percent). Over 55 percent of the visits report participating in relaxing and viewing scenery (USDA Forest Service 2011b and 2006). The 10 most popular recreation activities on the Inyo National Forest in 2006 and 2011 are listed below.

- viewing natural features
- relaxing
- downhill skiing
- hiking/walking
-)viewing wildlife
- driving for pleasure
- nature center activities
- developed camping
- picnicking (in 2011)
- resort use (in 2011)
- fishing (in 2006)
- visiting historic sites (in 2006)

In addition to the most popular recreation activities listed above, dispersed recreation activities occur throughout the national forest in undeveloped or general forest areas where there are few or no facilities. Dispersed recreation includes a wide range of outdoor motorized and nonmotorized recreation opportunities that are available throughout the year. Activities may include but are not limited to activities such as camping, hiking, horseback riding, off-highway-vehicle driving or riding, rock climbing, mountain biking, wildlife viewing, fishing, hunting, cross-country skiing, snowmobiling, visiting historic sites and scenic areas, and exploring the national forest. Dispersed recreation opportunities can be found in all recreation opportunity spectrum classes.

Table 77 shows the total estimated forest visitation on the Inyo National Forest based upon the most recent NVUM data available from 2006 and 2011. There was an estimated 2.5 million national forest visits to the Inyo NF in 2011. Key recreation access road closures on the national forest during 2011 may account for the drop in total forest visits from 2006 to 2011. The total estimated recreation site visits increased to 5.5 million on the national forest in 2011, which was more than double the estimated recreation site visits in 2006. Another notable increase in visitation was the increase in wilderness visits which nearly doubled from 2006 to 2011 (USDA Forest Service 2011b, 2006).

Table 77. Forest visitation numbers (in thousands)

Visit Type	2006	2011
Total estimated national forest visits to Inyo*	2,862	2,530
Total estimated site visits**	2,738	5,495
General forest area estimated visits	748	978
Day use developed estimated site visits	2,738	2,524
Overnight developed site estimated visits	907	1,741
Designated wilderness estimated visits	138	252

*A national forest visit is defined as the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. A national forest visit can be composed of multiple site visits

** A site visit is the entry of one person onto a national forest site or area to participate in recreation activities for an unspecified period of time. Sites and areas were divided into four site types as listed here

Demographic results from the 2011 National Visitor Use Monitoring survey data results available show that very little visitation on the Inyo National Forest is local; more than three-quarters of visits come from people who live more than 200 miles away from the national forest. Among racial and ethnic minorities, the most commonly encountered are Hispanic/Latino (10 percent) and Asian (5 percent). The age distribution shows that the Inyo has a very high proportion of children in the visiting population. About 30 percent of visits are under the age of 16. People over the age of 60 account for about 15 percent of visits (USDA Forest Service 2011b).

The Inyo National Forest has recreation sites under special use permit, which are more commercial in nature, and for a fee offer a variety of services. Included are resorts, downhill ski resorts, recreation residences, improved cross-country ski trails, recreation events, marinas, and organizational camps. Recreation special uses can provide for recreation access and recreation experiences that the Forest Service doesn't typically provide.

The Inyo National Forest currently manages a total of 534 recreation special use authorizations; of those, there are 350 recreation residence permits, 82 outfitter and guide permits, 32 resort permits, 19 recreation events permits, 5 permits for marinas, and several other types of recreation special use permits.

Key recreation sites or areas on the Inyo National Forest include Mount Whitney, Mammoth Mountain and June Mountain Ski Areas, Mammoth Lakes Basin, Mono Lake, June Lake, Coyote Flat, Bishop Creek, Whitney Portal, Papoose Flat, the Ancient Bristlecone Pine Forest, Reds Meadow, Buttermilk climbing area, the Kern Plateau, Ansel Adams and John Muir Wilderness Areas, and Rock Creek. Many of these key recreation sites or areas receive high amounts of concentrated recreation use.

Environmental Consequences to Sustainable Recreation

Consequences Specific to Alternative A

Existing plan direction is based on recreation uses and demand in the late 1970s and 1980s, prior to the current plan being developed. The current plan focuses on improving recreation opportunities by concentrating on the maintenance, development, adaptation, or alteration of recreation sites consistent with the recreation opportunity spectrum class where each site is located. Partnerships and volunteer opportunities are referenced to increase the amount of trails and facilities managed to desired standards.

Recreation Settings and Opportunities

The recreation opportunity spectrum is the primary management tool of recreation settings in the existing plan. The primary difference in management of recreation settings between this alternative and alternatives B, C, and D is the slight change of recreation opportunity spectrum classes (primarily primitive and semi-primitive nonmotorized) based on acres of recommended wilderness per alternative. There is no recommended wilderness in alternative A.

Table 78 shows the recreation opportunity spectrum classes for the existing forest plan (alternative A) and for alternatives B, B-modified, C, and D, which present variations of the desired recreation opportunity spectrum in acres and percent. Maps of the recreation opportunity spectrum classes for the Inyo National Forest can be found in volume 3.

In the current plan, the largest recreation opportunity spectrum class on Inyo National Forest is primitive at 53 percent followed by roaded natural (15 percent) and semi-primitive motorized (14 percent). When the two nonmotorized settings are combined (primitive and semi-primitive nonmotorized), this alternative provides 65 percent of the national forest in a nonmotorized setting. Combining the motorized setting (semi-primitive motorized, roaded natural, roaded modified and rural), this alternatives provides 32 percent of the national forest in a motorized setting.

Table 78. Existing (alternative A) and desired (alternatives B and B-modified, C, D) recreation opportunity spectrum classes in acres and percentage of national forest by alternative

Class	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Primitive	1,061,318 53 percent	1,092,748 55 percent	1,092,340 55 percent	1,334,083 67 percent	1,084,095 55 percent
Semi-primitive nonmotorized	241,504 12 percent	221,532 11 percent	227,093 11 percent	97,763 5 percent	229,442 12 percent
Semi-primitive motorized	286,784 14 percent	365,264 18 percent	366,899 18 percent	264,209 13 percent	365,861 18 percent
Roaded Natural	291,980 15 percent	239,287 12 percent	233,632 12 percent	223,688 11 percent	239,432 12 percent
Roaded Modified	49,011 2 percent	47,645 2 percent	46,562 2 percent	47,078 2 percent	47,645 2 percent
Rural	13,853 1 percent	19,300 1 percent	19,300 1 percent	19,011 1 percent	19,300 1 percent
Urban	0	0	0	0	0
Unassigned	41,342 2 percent	0	0	0	0

Existing management direction under alternative A would not direct the Inyo to adequately manage recreation opportunities and settings, since the current forest plan was developed almost 30 years ago. The current plan does not account for changing uses, emerging uses, or changing demographics. A good example of a changing use not adequately reflected under alternative A is that the technology advancements for motorized over-snow vehicles since the last forest plan was written increased their ability to access different areas. This change also has implications with nonmotorized opportunities, as over-snow vehicles can be used to access remote backcountry areas for winter nonmotorized activities. Outdated recreation opportunity spectrum classifications currently exist as a result of changes in management and land status since the plan was written. The current recreation opportunity spectrum under alternative A would not adequately capture valued recreation settings and opportunities.

Management direction in the existing plan does not provide a range of year-round developed and dispersed recreation settings that offer a variety of motorized and nonmotorized opportunities and recreation experiences.

The existing plan also does not recognize decreasing budgets, which could affect the ability to effectively manage recreation settings across the recreation opportunity spectrum. As a result of decreasing budgets, alternative A would not provide adequate management direction on the need for partnerships and volunteers to help manage recreation opportunities and settings across the recreation opportunity spectrum.

The existing plan would not ensure a sustainable recreation program on Inyo National Forest, this is particularly true for unmanaged recreation, where timely response to new uses that have potential ecological effects would be necessary into the future. The current forest plan also lacks the direction to adaptively manage new and emerging uses.

Without a change in current trends of forest conditions that could adversely affect recreation settings (such as stand replacing wildfire, disease, and mortality) there would potential for adverse effects on recreation settings. These recreation settings are what provides for the recreational opportunities such as hiking, wildlife viewing, and fishing. There would likely be short-term impacts on recreation settings which could displace recreational visitors to unaffected areas. There would also be long-term impacts without restoration activities and overall limited treatment rates due to a decline in quality of the recreation settings without restoration activities identified in plan revision alternatives.

Under the existing plan, 17 critical aquatic refuges will be retained instead of conservation watersheds developed under B-modified. Critical aquatic refuges are intended to provide protection to aquatic species; however, they are not intended to prohibit recreation uses. In the event recreation uses would have negative impacts on critical aquatic refuges, changes to the physical recreation setting may be necessary such as hardening a creek crossing or a necessary trail re-route, but the recreation activity would likely not become prohibited. Alternative A has a slightly less number of critical aquatic refuges than alternatives B and D, and alternative C has the highest number of critical aquatic refuges.

Access

Existing recreation opportunity spectrum settings would not change under alternative A; therefore, there would be no impact to nonmotorized, motorized or mechanized transport access under this alternative. The number of miles of access roads and trails would remain the same under alternative A. The average number of miles per year of trails that meet Forest Service standards under alternative A would remain the same (969 miles), which is roughly 58 percent of the trail system.

There is no recommended wilderness in this alternative; therefore, there would be no impact to mechanized access (mountain bike use) since there would be no change in the miles of system trails that allow mountain bike use. The number of miles of motorized trails and roads available would not be impacted since there would be no change.

Although there is no change to the number of miles of roads and trails available under alternative A, management direction under alternative A would not provide direction for motorized and nonmotorized trail systems that meet current demands, uses; as well as managing conflicting uses. This would likely have negative impacts on future trail management without relevant direction to meet current demands and uses. There is also no current direction provided for trail connectivity, linkages to local communities, or access to destinations, all of which are a critical component of trail access.

Alternative A does not provide direction to adequately manage motorized and nonmotorized trails given that budgets are expected to decline. There is limited emphasis in the existing plan on using volunteers and partnerships to help manage trails with fewer federally appropriate funds available. Without adequate management direction for using volunteers and partnerships, there would be likely be adverse effects to trails since they would not be maintained to Forest Service standards.

Without a change in current trends of forest conditions (such as stand-replacing wildfire, disease, and mortality), there would be potential for negative effects to recreation access. These impacts would likely be short term in nature as roads and trails could be closed due to catastrophic wildfires or hazardous conditions along roads and trails from hazard trees.

Facilities and Level of Development

Management direction under the current forest plan would not provide a framework for how the Inyo will improve, manage, or limit existing recreation sites along with a potential management approach that speaks to redesigning, restoring and rehabilitating sites if unacceptable resource impacts are occurring. A lack of direction on managing these recreation sites into the future would have negative impacts on managing existing recreation facilities and could result in closures of recreation sites or an absence of creating new recreation facilities where demand and use warrant additional infrastructure.

The current plan also does not provide direction to manage the condition, function, and accessibility of recreation facilities to accommodate a diverse public. A lack of clear management direction would likely have negative impacts on maintenance, condition, and accessibility of recreation facilities. This could also result in the Inyo's failure to provide an adequate number of facilities to meet the demands of the public.

Current management direction under alternative A also does not provide integrated direction for managing and operating recreation facilities in a changing environment, and does not respond to changes in visitor demands and uses (or environmental conditions) that may be needed to make changes to facilities or possibly alter access to recreation facilities. Without an integrated and responsive approach to managing these facilities, recreation development and facilities would likely be negatively impacted and could result in closure or under-utilization.

Visitor Use

The existing plan does not provide direction for managing visitor use. The current plans's recreation management approach is more concentrated and emphasizes improving recreation opportunities by focusing on recreation sites rather than managing visitor use. Without direction on managing visitor use, visitor experiences could be negatively impacted without responding to visitor conflict, crowding, or under-represented uses.

The existing plan does not provide a framework for informing management decisions on current and future activities and visitor expectations. This would have negative outcomes on the availability of a broad range of visitor activities and the national forest would likely fail to meet visitor expectations.

There is no direction under the existing plan to adapt to changes in visitor use levels, patterns of use, or the necessity to protect resources where over-use or incompatible uses occur. Without clear management direction on managing visitor uses, visitor experiences could be negatively impacted if crowding is perceived where it is not expected or unintended resource damage could cause closure of recreation sites or areas.

The existing plan lacks management direction on when and where it is appropriate to emphasize recreation special use authorizations. As a result, special uses would likely be issued where they may not be appropriate and could cause over-crowding in areas, or the use could exceed the sustainability of the natural and cultural resources that support these activities. Visitor experiences would likely be negatively impacted under this alternative if visitors experience crowding or conflict.

Consequences Common to Alternatives B, B-modified, C, and D

There would be an increase in restoration activities in all plan revision alternatives; therefore, all of these alternatives provide greater potential to improve the long-term sustainability of recreation opportunities and settings in comparison to alternative A, which maintains current restoration activity levels.

The plan revision alternatives do have the potential for short-term adverse effects to recreation settings and opportunities by displacing visitors during restoration activities, but this is negligible given that it is short term in nature and recreation sites and settings would be protected in the long term.

Consequences Specific to Alternative B

Recreation Settings and Opportunities

Alternative B's recreation management strategy stems from the recreation opportunity spectrum and the concept of place-based management areas (referred to as recreation places), which are characterized by their distinctive roles and contributions within the broader landscape. There are 16 recreation places spanning the entire Inyo National Forest under alternative B. Each is centered on a central theme and consists of one broad desired condition that provides limited, general direction for management of the area related to scenery, recreation settings, recreation opportunities, and recreation sites and infrastructure. Each recreation place is categorized as one of six types: destination, dispersed use, high country, high-use overnight, scenic drive, or wildlands.

Though the recreation opportunity spectrum is the primary management tool of recreation settings in alternative B, this alternative does not contain descriptions of the characteristics of each recreation opportunity spectrum setting or associated plan components to achieve each desired recreation opportunity spectrum class. This alternative also provides little direction on integrating recreation settings with other resources which could cause unintended negative impacts to resources or recreation experiences if resource conditions degrade under this alternative.

Alternative B only provides direction for managing summer recreation settings; it does not provide the management for both summer and winter recreation opportunity spectrum settings. This alternative also contains unsuitable desired conditions for over-snow, winter recreation because they are specific to summer recreation opportunity spectrum settings. Because alternative B does not manage for winter recreation settings, this alternative is not responsive to the change in winter recreation opportunities. Recent advances in over-snow vehicle technologies have increased the range and demand for access to backcountry skiing, snowboarding, and snowshoeing. There is no direction provided for a range of winter recreation opportunities under alternative B, which would likely have negative consequences on winter recreation opportunities.

Under alternative B, 18 critical aquatic refuges would be maintained instead of conservation watersheds developed under B-modified. Critical aquatic refuges are intended to provide protection to aquatic species; however, they are not intended to prohibit recreation uses. In the event recreation uses would have negative impacts on critical aquatic refuges, changes to the physical recreation setting may be necessary such as hardening a creek crossing or a necessary trail reroute, but the recreation activity would likely not become prohibited. Alternatives B and D have the same number of designated critical aquatic refuges, alternative A has slightly fewer, and alternative C has the highest number.

In alternative B, the largest recreation opportunity spectrum class on the Inyo National Forest would be primitive class at 55 percent of the national forest followed by semi-primitive motorized (18 percent), and then by roaded natural (12 percent). When the two nonmotorized settings are combined, these alternative would result in 66 percent of the Inyo in a nonmotorized setting. Combining the motorized settings, these alternatives would provide a motorized setting on 33 percent of the national forest. The amount of nonmotorized setting in this alternative would be the similar to alternatives B-modified and D, and less than alternative C. Like alternative B-modified, a slight increase in nonmotorized recreation opportunity spectrum settings would be beneficial to nonmotorized recreation opportunities as it increases opportunities for wilderness-based opportunities that require solitude and quiet recreation activities. A slight decrease in motorized settings available would be a negligible impact to motorized opportunities considering there would be no motorized route closures as a result of the recommended wilderness areas.

Recreation opportunities are the opportunities to participate in a specific activity in a particular recreation setting to enjoy a desired recreation experience. The recreation opportunity spectrum provides the primary guidance for recreation opportunities in alternative B (similar to alternatives C and D). The primary difference in management of recreation opportunities between these alternatives is the slight change in access due to differences in recommended wilderness alternatives B and D compared with alternative C.

Like alternative B-modified, alternative B provides a framework to inform management decisions on current and future activities and visitor expectations that is not present under the current plan. This is particularly important given that visitor use is expected to increase with potential for changing and new uses. Although alternative B does not have the integrated and adaptive management approach under the sustainable recreation zones of alternative B-modified, its management framework would still improve recreation opportunities and experiences on the national forest to meet the demands and expectations of visitors, and it is responsive to the changing and emerging uses not present under the current plan.

This alternative, like alternative B-modified, provides direction to ensure recreation opportunities provide a high level of visitor satisfaction and that the range of recreation activities provide social and economic sustainability. This would be a beneficial impact to recreation opportunities.

Access

Under alternative B (like alternative B-modified) there are four recommended wilderness areas, none of which contain any system trails that allow bicycle use; therefore, there would be no change in miles of system trails that allow mechanized transport. Within the four recommended wilderness areas there are no existing system motor vehicle routes or open areas; therefore there would be no impact to the miles of motorized or nonmotorized system trails, roads, or open areas allowing motorized use.

Like alternative B-modified, this alternative provides direction to increase transportation systems to connect people to nature, improve personal health, and increase access for underserved communities, minorities and urban youth. This would be a beneficial effect to recreation access. It also provides

Management direction under alternative B (like B-modified) provides for motorized and nonmotorized trail systems that meet current demands and uses; as well as managing conflicting uses which would be a beneficial impact to trail access as compared to alternative A. The alternative (like B-modified) also emphasizes trail connectivity, linkages to local communities, and access to destinations which is a beneficial impact to trails, and social and economic stability.

Management direction related to recreation access under alternative B does not offer a different focus across different recreation zones and assigned recreation opportunity spectrum settings, direction is based solely upon the assigned settings. Without a focus on different emphasis zones, the Inyo lacks direction on where to prioritize trail management.

Alternative B (like alternative B-modified) provides a framework to manage motorized and nonmotorized trails into the future given that budgets are expected to decline. There is emphasis placed upon using volunteers and partnerships to help manage trails with less federally appropriate funds available. Under this alternative, 75 percent of the national forest designated trail system would be maintained to standard and 25 percent of the deferred maintenance on trails would be addressed through partnerships. This would be a beneficial impact to public's access to motorized and nonmotorized trails. However, without clear direction on how that access will be managed and prioritized across the national forest, utilizing partnerships under this alternative would not be as beneficial as under alternative B-modified.

With the restoration activities that will occur under alternative B (as under B-modified, C, and D) there would be potential for short-term negative effects to recreation access if roads or trails are closed during restoration activities, but this is negligible given that it is short-term in nature. Restoration activities would have beneficial impacts to access in the long-term because as ecosystems are restored over time, it would be less likely that roads and trails would be closed due to catastrophic wildfires or hazardous conditions along roads and trails from tree mortality or fires.

Facilities and Level of Development

Alternative B (similar to alternative B-modified) provides direction to manage recreation facilities and ensure they are place based, integrated, and responsive to changes that may limit or alter access. This integrated approach provides for facilities to meet user demands while ensuring resources are protected. This would benefit developed recreation because it allows for redesigning, restoring, or rehabilitating recreation sites where recreation activities have caused unacceptable natural or cultural resource damage. Like alternative B-modified, one of the trade-offs when compared with the alternative A is that it provides the framework to restore recreation facilities that are underutilized or causing resource damage, but ultimately this would benefit developed recreation because it allows the Inyo to focus managing only recreation sites that are needed while protecting resources. This would help meet desired conditions and ensure that recreation facilities are maintained to desired conditions.

Under alternative B (like alternative B-modified) there is a focus on partnerships and community stewardship to help the Inyo operate and maintain recreation facilities with opportunities such as the establishment of "adopt a facility" programs. This would be a benefit to the condition of recreation facilities across the national forest and help the Inyo meet desired conditions.

Under alternative B, there is no specific framework provided to ensure recreation development is suitable across the different areas of the national forest, there is only the recreation opportunity spectrum settings that guide management of facilities under this alternative. A lack of specific direction on when and where additional development would be appropriate across different areas and recreation opportunity spectrum settings on the Inyo would likely cause adverse impacts if facilities do align with user demands and uses. This alternative does not direct the Inyo to focus developed recreation management in areas where the highest use is occurring and greatest demand. This would likely cause negative impacts to the condition of facilities as the Inyo could end up with more facilities than they can manage.

Alternative B does not provide integrated and adaptive direction for managing and operating sustainable recreation facilities in a changing environment. Unlike alternative A, this alternative recognizes there will be new and changing uses, but without an adaptive and integrated approach to designing and managing recreation infrastructure, the Inyo could end up with unnecessary facilities, facilities that impact sensitive resources, or recreation facilities that conflict with user expectations or uses. Without an integrated and responsive approach to development and management of these facilities, recreation facilities would likely be negatively impacted and could result in closure or under-utilization of these facilities.

Visitor Use

Alternative B recognizes that visitor use and demand will continue to increase, which alternative A does not do, but since direction is based solely upon the recreation opportunity spectrum, it does not provide for an adaptive and integrated approach to managing visitor use. Without an adaptive and integrated approach to managing visitor use, visitor experiences would be negatively impacted without responding to visitor conflict, crowding, or under-represented uses.

There is also no direction under alternative B to adapt to changing patterns of use, or the necessity to protect resources where over-use or incompatible uses occur. Without adaptive management direction on managing changing patterns of use across different settings on the national forest, visitor experiences could be negatively impacted if crowding is perceived where it is not expected or unintended resource damage could cause closure of recreation sites or areas. This would negatively impact visitor expectations.

Like alternative A, alternative B lacks specific management direction on when and where it is appropriate to emphasize recreation special use authorizations, it only ensures that they are consistent with recreation settings. As a result, special uses could likely be issued where they may not be appropriate and could cause over-crowding in areas, or the use could exceed the sustainability of the natural and cultural resources that support these activities. Visitor experiences would be negatively impacted under this alternative if visitors experience crowding or conflict where it is not expected.

Consequences Specific to Alternative B-modified

Recreation Settings and Opportunities

Table 78 shows that in alternative B-modified, the largest recreation opportunity spectrum class would be primitive at 55 percent of the national forest followed by semi-primitive motorized (18 percent), and then by roaded natural (12 percent). When the two nonmotorized settings are combined, this alternative would result in 66 percent of the Inyo in a nonmotorized setting. Combining the motorized settings, these alternatives would provide a motorized setting on 33 percent of the national forest. This slight increase in nonmotorized recreation opportunity spectrum settings would be beneficial to nonmotorized recreation opportunities since it has the biggest increase in wilderness-based opportunities that require solicitude and a remote setting.

There would be a slight decrease in motorized recreation settings from the current plan (alternative A) due to the recommended wilderness areas; however, this impact is considered negligible since it would not result in any closures of motorized routes.

The amount of nonmotorized settings in alternative B-modified is similar to alternatives B and D, but less than alternative C. The amount of motorized settings under alternative B-modified in these alternatives would be similar to alternatives B and D, but higher than alternative C.

Alternative B-modified is the only alternative that provides direction to manage recreation settings through a zoned approach. The sustainable recreation zones provide direction for the Inyo to offer a variety of recreation opportunities, integrating the different recreation opportunity spectrum settings under each of the three zones. The three recreation management zones under alternative B-modified manage for a continuum of recreation user densities across the three zones: from a high-concentration of recreation activities to a low-density of recreation activities, providing for a full spectrum of recreation opportunities and experiences. The zone management approach would be beneficial to recreation settings because it supports a diversity of settings across the recreation opportunity spectrum, including the level of facility development allowed in each setting. Recreation opportunity spectrum is incorporated into each of the recreation management zones and is a clear descriptor in the desired condition of each area, which would ensure that recreation facilities and activities match the setting and zone.

Alternative B-modified recognizes there are gradations of recreation use levels and types within the same recreation opportunity spectrum class and polygon. Table 79 and figure 32 show the different recreation opportunity spectrum settings and how they would be managed across the three different recreation zones.

Table 79. Recreation opportunity spectrum settings of recreation zones in alternative B-modified (acres and percentage of forest)

Sustainable Recreation Zone	Primitive	Semi-Primitive Nonmotorized	Semi-Primitive Motorized	Roaded Natural	Roaded Modified	Rural
Destination Recreation Area (High use)	990 0 percent	6,118 3 percent	1,069 0 percent	128 0 percent	23,662 51 percent	11,397 59 percent
General Forest Recreation Area (Mixed/Moderate Use)	5,551 1 percent	49,130 22 percent	71,751 20 percent	172,565 74 percent	19,147 41 percent	7,762 40 percent
Challenging Backroad Area (Low Use)	82,301 8 percent	149,140 66 percent	263,360 72 percent	48,488 21 percent	52 0 percent	0 0 percent

As shown in table 79 and figure 32, the Destination Recreation Zone would provide the least amount of primitive and semi-primitive settings, but this would be appropriate in the high use areas of this zone type where the rural and roaded modified settings are suitable for high use. The Challenging Backroad Area would provide the most nonmotorized settings, which would also be appropriate for this type of zone where minimal facilities and management would be needed. The zoned approach would have beneficial impacts to recreation settings and opportunities as it would ensure that a broad range of visitor experiences are provided across the different zones and recreation opportunity spectrum settings. Rather than recreation opportunity spectrum providing the sole direction for recreation opportunities under alternative B, alternative B-modified integrates components of recreation opportunity spectrum classes, both summer and winter, to provide a framework to adaptively manage recreation.

The zoned management approach to recreation management under alternative B-modified would provide for expansion of recreational opportunities under the General Recreation Area if warranted by visitor use and demands. This would be a beneficial consequence to recreation opportunities as it would increase opportunities available.

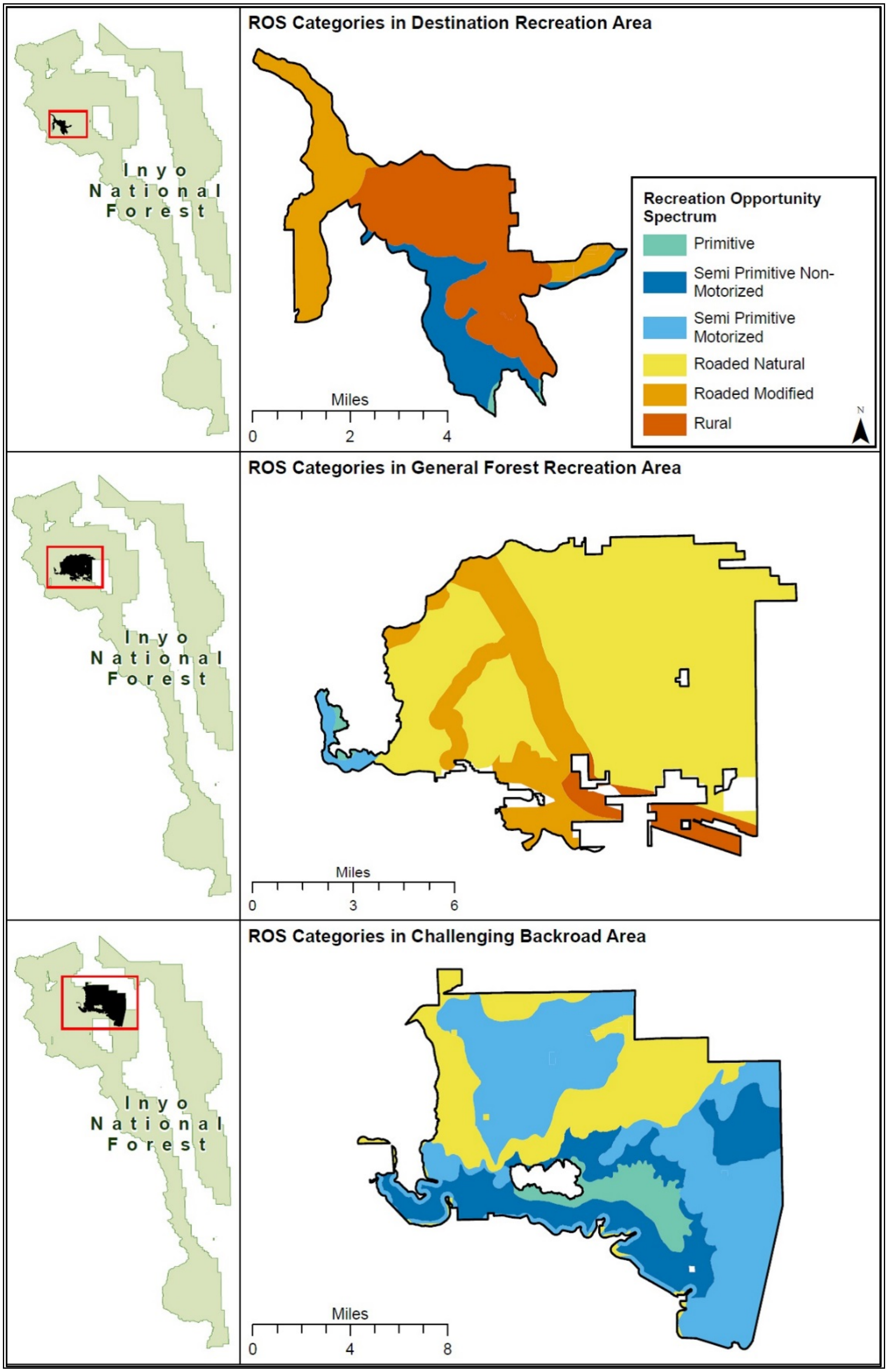

Figure 32. Recreation opportunity spectrum (ROS) categories within sustainable recreation zones in alternative B-modified

Alternative B-modified, like alternative B, provides a framework to inform management decisions on current and future activities and visitor expectations. This is particularly important given that visitor use is expected to increase with potential for changing and new uses. The management framework under alternative B-modified would be beneficial to ensuring recreation opportunities and experiences on Inyo National Forest meet the demands and expectations of visitors and is responsive to the changing and emerging uses.

This alternative, like alternative B, provides direction to ensure recreation opportunities provide a high level of visitor satisfaction and that the range of recreation activities provide social and economic sustainability. This would be a beneficial impact to recreation opportunities.

Alternative B-modified is the only alternative which provides direction to manage both summer and winter recreation opportunity spectrum settings. A winter recreation opportunity spectrum map is included in appendix A of the final revised plan, which depicts the location, mix and distribution of setting attributes, access, and associated winter opportunities (both motorized and nonmotorized). Distinct seasonal changes in the recreation settings and opportunities are integrated with relevant multiple uses, resource values, and management objectives. Future planning efforts, such as for subpart C of the Travel Management Rule (over-snow vehicle travel designations) could further modify recreation opportunity spectrum boundaries for either motorized or nonmotorized winter characteristics. The addition of the winter recreation opportunity spectrum settings in alternative B-modified sets a basis for managing winter recreation opportunity spectrum settings and as a result would be a positive effect to winter recreation opportunities, both motorized and nonmotorized.

Under alternative B-modified, direction is provided for an integrated approach to managing recreation settings that have been impacted by declining ecosystem health, wildfire, and unsuitable uses. This would improve affected recreation settings by ensuring these settings would eventually be protected or restored to sustain the quality of outdoor experiences.

Under Alternative B-modified, conservation watersheds would be designated instead of critical aquatic refuges under the other alternatives. Conservation watersheds, although covering more acreage than critical aquatic refuges in alternatives A, B, C, and D, do not include any plan language that prohibits, or restricts recreation use or activities. Recreation direction within conservation watersheds specifies that any site-specific activities that occur within the Destination or General Recreation Areas will continue to promote the maintenance or restoration of the Watershed Condition Framework indicators (MA-CW-STD-01). As long as recreation uses within conservation watersheds continue to maintain functioning aquatic systems, recreation opportunities and settings would not be impacted under alternative B-modified. In the event recreation uses would have resource impacts on conservation watersheds, changes to the physical recreation setting may be necessary such as hardening a creek crossing or a necessary trail re-route, but the recreation activity would likely not become prohibited. Recreation opportunities such as fishing and other downstream recreation opportunities would likely be enhanced from watershed improvements done in conservation watersheds as the health of watersheds is improved.

Alternative B-modified is responsive to changing uses, new uses, and a diverse public and ensures management focuses on settings that enhance Inyo National Forest recreation program niche. This alternative would benefit recreation opportunities by ensuring that a variety a broad range of year-round recreation opportunities would be provided to the public and that the Inyo has direction to respond to changing uses and new uses.

Access

Under alternative B-modified, there are four recommended wilderness areas, none of which contain any system trails that allow bicycle use; therefore, there would be no change in miles of system trails that allow mechanized transport. Within the four recommended wilderness areas there are no existing system motor vehicle routes or open areas; therefore there would be no impact to the miles of motorized or nonmotorized system trails, roads, or open areas allowing motorized use.

Alternative B-modified seeks to increase transportation systems to connect people to nature, improve personal health, and increase access for underserved communities, minorities, and urban youth. This would be a beneficial effect to recreation access. The average number of miles per year of trails that meet Forest Service standards would increase to 1,100-1,300 miles under alternative B-modified (66 to 78 percent of the trails would meet standard) as opposed to 58 percent of the trails meeting standard under alternative A, the current plan. This would be a benefit to access, since a higher percentage of trails would meet standard.

Management direction under alternative B-modified provides for motorized and nonmotorized trail systems that meet current demands and uses; as well as managing conflicting uses, which would be a beneficial impact to management of trails as compared to the existing plan. This alternative also emphasizes trail connectivity, linkages to local communities, and access to destinations, which is a beneficial impact to trails, and social and economic stability.

Proposed wilderness recommended additions under B-modified would not reduce motorized or mechanized (mountain bikes) access to the national forest or adjacent lands since there are no motorized routes or mechanized routes proposed for closure due to the recommended wilderness additions or eligible wild and scenic rivers in alternative B-modified. Management of the Pacific Crest Trail under this alternative would not affect any existing mechanized or motorized access routes.

Under alternative B-modified access, opportunities for pack stock would not be affected. There are two existing horse camps on the Inyo National Forest, both of which are outside of wilderness areas and would not be negatively impacted. Furthermore, wilderness designation generally allows customary nonmotorized and nonmechanized use which usually includes use of pack and saddle stock. This would not change under alternative B-modified (or any of the alternatives), thus a sustainable level of pack and saddle stock access would continue to be retained.

The key difference between B-modified and the other alternatives in terms of user access is that alternative B-modified uses the zone management approach, which offers a different focus on roads and trails across the different recreation zones and assigned recreation opportunity spectrum settings. This allows the Inyo to place a management emphasis on managing road and trail systems, particularly in the Destination Recreation Areas, which will provide roads and trails for relatively easy access for users. This management framework would be beneficial to management of trails because it would allow the Inyo staff to focus more on ensuring trails within those areas would be maintained to standard. Within the General Recreation Areas, recreation opportunities have room to expand, therefore new trails could be built to provide additional opportunities resulting in a beneficial impact to access.

Alternative B-modified provides a framework to adequately manage motorized and nonmotorized trails into the future given that budgets are expected to decline. Alternative B-modified places an emphasis upon volunteers and partnerships to help manage trails with less federally appropriate funds available. Under this alternative, 75 percent of the national forest designated trail system would be maintained to standard and 25 percent of the deferred maintenance on trails would be addressed through partnerships. This would be a beneficial impact to public access to motorized and nonmotorized trails.

With the restoration activities that would occur under alternative B-modified (along with alternatives B, C, and D) there is potential for negligible short-term negative effects to recreation access if roads or trails are closed during restoration activities. In general, restoration activities would have beneficial impacts to access in the long term because as ecosystems are restored over time, it would be less likely that roads and trails would be closed due to catastrophic wildfires or hazardous conditions along roads and trails from tree mortality or fires.

Facilities and Level of Development

Alternative B-modified provides direction to manage recreation facilities and ensure they are place based, integrated, and responsive to changes that may limit or alter access. This integrated approach provides for facilities to meet user demands while ensuring resources are protected. This would benefit developed recreation because it allows for redesigning, restoring, or rehabilitating recreation sites where recreation activities have caused unacceptable natural or cultural resource damage. One of the trade-offs in this alternative when compared with alternative A is that it provides the framework to restore recreation facilities that are underutilized or causing resource damage, but ultimately this would benefit developed recreation because it allows the Inyo staff to focus managing only recreation sites that are needed while protecting resources. This would help meet desired conditions and ensure that recreation facilities are maintained to desired conditions.

Under alternative B-modified there is a large focus on partnerships and community stewardship to help the Inyo operate and maintain recreation facilities with opportunities such as the establishment of “adopt a facility” programs as an example.

Under alternative B-modified, the zoned management approach provides direction on the management of recreation facilities across the different zones and settings. This is the only alternative that provides the framework to ensure recreation development fits within the three zones and recreation opportunity spectrum settings. This would be a benefit to recreation facilities and the level of development because it provides direction on when and where additional development is appropriate across the zones and recreation opportunity spectrum settings, as long as partnerships are available to assist with the management and maintenance of any new infrastructure. This alternative would allow the Inyo staff to focus management on the High Density Recreation zones where there are the highest number of visitors, and where the greatest user demand for highly developed facilities. The General Recreation Areas would be where the Inyo could also consider additional facilities to provide access to dispersed recreational activities.

Visitor Use

Recreation use patterns, amount, and types vary across a landscape and change with time. Alternative B-modified recognizes visitor use and demand will continue to increase, making appropriate, adaptive management a critical component to achieving sustainable recreation. This alternative also provides a framework to adapt to changing uses and new uses that may emerge. Alternative B-modified acknowledges that tradeoffs may be necessary to ensure resources are managed sustainably, but overall, this management approach would be beneficial to ensuring visitor use is adequately managed, resources are protected, and visitors have a quality recreation experience.

Partnerships and volunteer opportunities are considered necessary to continue to meet visitor needs. Recreation uses would be managed adaptively to prevent impacts to other resources and recreation settings. Plan components emphasize partnership opportunities to provide stewardship and interpretive services that educate forest visitors, enhance responsible behaviors, and improve etiquette. Alternative B-modified recognizes that user conflicts exist and that expanding recreation activities creates more opportunities for visitors, but also more opportunities for conflict. Plan components direct the Inyo to seek collaborative input on sustainable recreation opportunities to address potential conflicts between activities and any resource impacts that may be of concern. This approach to management would be beneficial, because it would likely help ensure the visitor expectations are met by reducing conflicts.

Alternative B-modified provides direction to encourage recreation special use permits such as recreation special events or guided activities when they are consistent with recreation zones and settings, protect natural and cultural resources, and contribute to the economic sustainability of local communities. This would be a beneficial consequence to visitor experiences, as it provides more recreation opportunities for visitors to have quality outdoor experiences within the appropriate zone or setting. The trade-off is that some recreation special uses may not be appropriate for allowing under this alternative if the use doesn't fit within the goals and settings for that zone.

The recreation zone approach under alternative B-modified provides the Inyo flexibility to manage activities differently from one location to another and to manage uses over time. This approach focuses management where it is most intensely needed, as well as the ability to manage recreation differently from one place to another, based on resource needs. In the General Recreation Zones and Challenging, Backroad Recreation Areas, it ensures visitor expectations for a more challenging and remote experience are met. This management approach would be beneficial to visitor experiences as it ensures visitor expectations are in line with settings across the different zones.

Alternative B-modified contains direction specific to the challenges of managing intensive recreation developments within the natural setting of the national forest, particularly those that are highly popular and iconic. These areas receive high levels of visitation and have a focus on managing high use levels and the accompanying support facilities. Overall this would be a beneficial impact to providing quality visitor experiences. Tradeoffs may include implementing management actions such as setting capacity limits or setting more management controls within the Destination Recreation Zones.

Alternative B-modified provides direction that protects the environment and cultural resources and manages for natural settings while still accommodating recreation use. It also directs the Inyo to manage recreation uses adaptively to prevent impacts to other resources and also speak to restrictions and restoration when negative impacts occur from recreation. The recreation zone approach provides the flexibility to be responsive to resource needs from one location to another. For example, destination recreation areas are high-use areas that would be managed more intensively in this alternative. Resource impacts would be concentrated and limited to hardened sites and conservation education and interpretation programs would focus on developing a land ethic as part of the recreation experience in these areas. Low-use density recreation areas would be focused on resource conservation.

Direction under alternative B-modified would be the most responsive out of all the alternatives at addressing resource impacts from a variety of recreation uses such as trail impacts from mountain bike use, off-highway vehicle use, equestrian use, and foot traffic. This alternative provides an adaptive approach that would help protect resources from impacts that may occur from increased use or inappropriate user behaviors. There is plan direction within the final revised plan that addresses recreational use impacts, such as impacts from trampling in riparian conservation areas (MA-RCA-STD-07 and -08).

Consequences Specific to Alternative C

Recreation Settings and Opportunities

Environmental consequences to recreation settings in alternative C are similar to alternative B except for the following.

Recreation opportunities under alternative C shift to larger areas of primitive and semi-primitive nonmotorized settings due to the recommendation of additional wilderness areas. Under this alternative, the largest recreation opportunity spectrum class on would be primitive at 67 percent, followed by semi-primitive motorized (13 percent), and then by roaded natural (11 percent). When the two nonmotorized settings are combined, this alternative would result in 72 percent of the Inyo in a nonmotorized setting. Combining the motorized setting, this alternative would provide a motorized setting on 27 percent of the national forest. The amount of nonmotorized setting in this alternative would be the highest of all alternatives. Conversely, the amount of motorized setting in this alternative would be the lowest of all alternatives.

The change in recreation opportunity spectrum settings in alternative C is due largely to the increase in recommended wilderness in this alternative over alternatives A, B, and B-modified, and D; which would increase nonmotorized settings to 72 percent under alternative C. This would be a beneficial consequence to nonmotorized opportunities because there would be an increase in wilderness-based opportunities that provide quiet solitude in a remote setting, and reduce probabilities of seeing or hearing motorized vehicles and other people in remote and predominately unmodified landscapes.

Motorized settings would decrease to 27 percent of the national forest under alternative C, providing less opportunity in settings that are more developed and in roaded areas that allow motorized activities. This would be a negative effect to the amount of acres of motorized opportunities provided, but this effect is considered somewhat negligible since no motorized routes would be impacted as a result of this alternative.

Under alternative C, 25 critical aquatic refuges would be designated instead of conservation watersheds developed under B-modified. Alternative C has a higher number of critical aquatic refuges compared to alternatives A, B, and D. Critical aquatic refuges are intended to provide protection to aquatic species; however, they are not intended to prohibit recreation uses. In the event recreation uses would have negative impacts on critical aquatic refuges, changes to the physical recreation setting may be necessary such as hardening a creek crossing or a necessary trail re-route, but the recreation activity would likely not become prohibited.

Access

Environmental consequences to access under alternative C are similar to alternative B except for the following.

Alternative C has the greatest impact on mechanized access (mountain bikes) out of all the alternatives because of the additional recommended wilderness areas. There are six recommended wilderness areas in this alternative that contain 43 miles of system trails which currently allow mountain bike use. A plan component (MA-WILD-SUIT-04) makes mechanized transport unsuitable in recommended wilderness areas; therefore, trail access by mountain bikes would be decreased by 43 miles on system trails, which is a 9 percent reduction in nonmotorized trails open to mountain bikes compared to A, B, B-modified, and D. Given the topography and sandy soils of where these trails are located, only a minor impact to mechanized access would be expected under this alternative.

If site-specific decisions were made to prohibit mountain bike use on these trails within the recommend wilderness areas, mountain bike access on system trails could decrease by 43 miles within recommended wilderness areas and mechanized transport would be allowed on 432 miles of nonmotorized system trails across the entire Inyo National Forest. A site-specific decision to close trails within recommended wilderness areas would need to be completed before an enforceable closure could be made to prohibit bicycle use. The trails would allow for mechanized use until a project-level decision was completed.

Facilities and Level of Development

Environmental consequences to facilities and development would be the same as alternative B.

Visitor Use

Environmental consequences to visitor use in alternative C is the same as alternative B.

Consequences Specific to Alternative D

Recreation Settings and Opportunities

Environmental consequences to recreation settings and opportunities in alternative D would be the same as alternative B except for the following.

In alternative D, the largest recreation opportunity spectrum class would be primitive at 55 percent of the Inyo National Forest, followed by semi-primitive motorized (18 percent), and then by roaded natural and semi-primitive nonmotorized (both 12 percent). When the two nonmotorized settings are combined, this alternative would result in 67 percent of the Inyo in a nonmotorized setting. Combining the motorized settings, this alternative would provide a motorized setting on 33 percent of the national forest. The amount of nonmotorized setting in this alternative would be higher alternatives A, B, and B-modified, but less than alternative C. Conversely, the amount of motorized setting in this alternative would be the same as alternatives B and B-modified, but higher than alternative C (see table 78 on page 488).

The primary difference in management of recreation settings between alternative D and the other alternatives is the slight change of recreation opportunity spectrum classes (primarily primitive and semi-primitive nonmotorized) based on the fact that there are no recommended wilderness areas in this alternative. However, despite the fact that there are no recommended wilderness areas, this alternative would provide the highest percentage of nonmotorized recreation opportunity spectrum settings resulting in a beneficial impact to nonmotorized recreation opportunities.

Access

Environmental consequences to recreation access in alternative D would be the same as alternative B.

Facilities and Level of Development

Environmental consequences to facilities and level of development in alternative D would be the same as alternative B except for the following.

This alternative provides the greatest benefit to protecting recreation facilities and infrastructure from catastrophic fires and tree mortality because of the direction it provides for the increased pace and scale of restoration and fuels treatments.

Visitor Use

Environmental consequences to visitor use in alternative D is the same as alternative B.

Cumulative Effects

Cumulative effects to sustainable recreation considered in this section are through the next planning period (estimated at 10 to 15 years).

Since it is assumed that population growth will increase recreation demands and visitation will continue to increase, there will be increasing demands on recreation that could result in higher concentrations of use at existing recreation areas and increased conflicts. This includes increasing demands on adjacent county lands. This could have negative cumulative impacts on the quality of recreation settings, including impacts to nearby county lands. All plan revision alternatives include direction that is responsive to increasing recreation demands, but alternative B-modified would be the most responsive to meeting recreation demands and ensuring the quality of recreation settings is retained and resources are protected across the different recreation zones.

Continuing changes in equipment technology used for recreational purposes on the Inyo National Forest may have effects on recreation opportunities and access, as new or existing uses may change the way visitors access the national forest or where they recreate. These changes in uses may alter the recreational experiences in some areas if uses are not compatible with one another or new uses create a sense of crowding where it is not expected. Changes to access and settings has the greatest potential to cumulatively impact the nonmotorized recreation opportunity settings, such as hiking or back-country skiing, where many visitors seek remote settings. Although all plan revision alternatives have some direction to respond to changing uses, alternative B-modified would be the most responsive to retaining the quality of recreation settings due to the adaptive manner in which this alternative responds to changing uses across the recreation zones.

Recreation in and surrounding the national forest, national parks as well as state and local lands does not follow administrative boundaries, and therefore changes in management of recreation on all of these lands together affects recreation use that would occur on the Inyo as well as adjacent lands. These cumulative changes may positively impact recreation settings and access, or they also have the potential to negatively impact settings and access if changes are not managed properly. Since the Eastern Sierra continues to have ever increasing visitation across all land jurisdictions, higher visitation could lead to increased resource impacts and crime, if use is not managed across all lands. Alternative B-modified provides the most adequate direction to adapt to changes that would have the potential to impact National Forest lands as well as adjacent lands.

Lands that were designated by Congress as wilderness in 2009 had no recreational facilities and little to no motorized route access, so there was minimal effect on access as a result of recent wilderness designations. The 2005 Travel Management rule, subpart B, required the Forest Service to designate roads, trails, and areas open to motor vehicle use. Designations were made by class of vehicle and, if appropriate, by time of year. The final rule prohibited the use of motor vehicles off the designated system, as well as use of motor vehicles on routes and in areas that is not consistent with the designations.[38] The Travel Management rule resulted in a reduction in the amount of motorized opportunities on National Forest System lands on the Inyo National Forest. The 2009 Travel Management Record of Decision on the Inyo National Forest designated more than 800 miles of routes that were previously not system roads, as maintenance level 2 roads, and approximately 157 miles of previously unauthorized motorized trails were added to the Forest Transportation System (USDA Forest Service 2009a). However, none of the plan revision alternatives in this planning effort affect any authorized system motorized routes; therefore, past wilderness designations in combination with proposed recommended wilderness in alternatives B, B-modified, and C would have minimal cumulative effects on motorized access, either on national forest lands or adjacent lands.

Since climate change is predicted to produce warmer temperatures and drier conditions influencing snowpack, drought, and hydrologic flow, activities dependent on snow and snow melt would be affected. Warmer temperatures could cause recreationists to shift their activities to higher elevations during the summer months (Morris and Walls 2009).These changes resulting from climate change could have the potential to alter the timing of summer recreational opportunities such as causing fishing opportunities to occur earlier and for a shorter season. This could also shift the timing of motorized and nonmotorized summer activities to occur earlier and for a longer season. Alternative D would provide direction for increased management activities to protect the physical settings where recreation activities occur; however, alternative B-modified provides the most effective management direction to be responsive to changes in recreation settings due to climate change. Alternatives B and C would provide adequate management direction that would be responsive to cumulative impacts from climate change.

Analytical Conclusions

Table 80 below provides a relative comparison of how the alternatives respond to indicators.

Comparison of recreation opportunity spectrum for the nonmotorized setting. Alternative A has the lowest amount of nonmotorized setting, but this is partly due to the recreation opportunity spectrum not being formally assigned to acquired lands. Alternatives B, B-modified, and D would have an increased motorized setting compared to alternative A, but less than alternative C. Alternative C would have the highest amount of nonmotorized setting due to the recommended wilderness areas and would be the most beneficial to the nonmotorized recreation setting. Alternative A would be the least beneficial to the nonmotorized recreation opportunity setting.

Comparison of motorized recreation opportunity spectrum setting. Alternative C has the lowest amount of motorized recreation opportunity setting with alternative A having the second lowest amount of motorized recreation opportunity spectrum setting. Alternatives B, B-modified, and D would have the highest amount of motorized setting with alternative D having slightly more due to not having any recommended wilderness areas. Alternative D would be the most beneficial impacts to the motorized recreation opportunity setting, but it is only slightly higher than alternatives B and B-modified.

[38] 36 CFR 212; Code of Federal Regulations, Title 36: Parks, Forests, and Public Property, Part 212: Travel Management

Change in miles of mechanized transport (mountain bike use). Alternative C has the biggest change in miles of mechanized transport due to the additional recommended wilderness areas with a decrease in 43 miles of trails available to mountain bikes. Alternative A has no change to the number of miles available to mechanized transport, and even though both alternatives B and B-modified have recommended wilderness, there is no change to the number of miles of trails available for mechanized transport. Alternative C would be the least beneficial at providing for mountain bike opportunities.

Change in miles of motorized routes. Proposed wilderness recommended additions under B-modified would not reduce access to the national forest or adjacent lands since there are no motorized routes proposed for closure due to the recommended wilderness additions or eligible wild and scenic rivers in alternatives B-modified, B, or C.

Effectively manages recreation development to respond to recreation demand and uses. Alternative A does not adequately manage recreation development because it does not recognize there will be new and changing uses; it also is not an adaptive and integrated approach that protects sensitive resources. Alternatives B, C, and D are only somewhat effective at managing recreation development because they do not provide integrated and adaptive direction for managing and operating sustainable recreation facilities in a changing environment while ensuring resources are protected. Alternative B-modified is the most beneficial to managing recreation development because it recognizes there will be new and changing uses and uses an adaptive and integrated approach to designing and managing recreation infrastructure.

Table 80. Comparison of indicators by alternatives

Indicator	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Comparison of amount of nonmotorized recreation opportunity spectrum setting	Lowest amount	Moderate amount	Moderate amount	Highest amount	Moderate amount
Comparison of motorized recreation opportunity spectrum setting	Second highest amount	Highest amount along with alternatives B-modified and D	Highest amount along with alternatives B and D	Lowest amount	Highest amount along with alternatives B and B-modified
Change in miles of mechanized transport (mountain bike)	No change	No change	No change	Decrease of 43 miles	No change
Effectively manages recreation development to respond to recreation demand and uses	Not adequate	Somewhat	Yes	Somewhat	Somewhat

Alternative A neither adequately manages recreation opportunities and settings in a changing environment nor provides a range of year-round developed and dispersed recreation settings that offer a variety of experiences. This would have negative impacts to ensuring quality summer and winter recreation opportunity spectrum settings are provided. There is also a lack of direction overall for access, facilities and development, and visitor use, because current direction does not recognize new and changing uses, nor is it an adaptive and integrated approach that protects sensitive resources. Its approach to managing visitor use is more concentrated and emphasizes improving recreation opportunities by focusing on recreation sites rather than managing visitor use. This alternative would be the least beneficial of all alternatives to recreation settings and opportunities, access, recreation facilities, and visitor use because of the lack of direction to adaptively managing recreation resources in a changing environment with changing uses and increased demands on recreation.

Alternative B provides direction that informs management decisions on current and future activities and visitor expectations that is not present under the existing plan, but it is not integrated and adaptive to respond to changing uses, environmental conditions, and demands. Like all plan revision alternatives, alternative B provides direction on using partnerships to help manage facilities, wilderness, and trails which is a benefit to managing these resources to desired conditions. However, overall, this alternative would result in less benefits to recreation settings and opportunities, access, facilities, and visitor use than alternative B-modified because it lacks an adaptive management approach across the different recreation zones in the face of changing demands and uses placed upon recreation resources. This alternative also only provides direction for managing summer recreation settings; which could negatively impact the quality of winter recreation opportunity spectrum settings.

Alternative B-modified provides management direction that is adaptive and responds to changes in both environmental conditions, uses, and visitor demands; utilizing partnerships and volunteers to help manage trails, facilities, and wilderness. It also provides direction to manage both summer and winter recreation opportunity spectrum settings. This alternative would be the most beneficial to recreation settings and opportunities, access, visitor use, and recreation development because of its adaptive management approach across the three different recreation zones and recreation opportunity spectrum settings, and recognition of changing demands and uses placed upon recreation settings, facilities and access. Alternative B-modified also strikes a balance between providing for restoration treatments, while still providing for areas recommended for wilderness designation. Alternative B-modified provides management direction that would result in the greatest overall benefit to recreation resources, while ensuring resource protection in a changing environment with increasing recreation demands.

Alternative C would result in the greatest benefit to nonmotorized recreation opportunities that provide quiet solitude in a remote setting because of the additional recommended wilderness areas. Conversely, this alternative would also result in the greatest negative impacts to motorized recreation settings because of the reduction in acres of motorized settings. Alternative C would also have the greatest negative impact on mechanized access (mountain bikes) out of all the alternatives because of the additional recommended wilderness areas. In all other aspects of recreation settings and opportunities, access, recreation facilities, and visitor use, alternative C would result in similar benefits as alternatives B and D to recreation settings and opportunities, access, facilities, and visitor use as because it also lacks an adaptive management approach in the face of changing demands and uses placed upon recreation resources.

Alternative D would have the greatest benefit to protecting recreation facilities and development from catastrophic fires and tree mortality because of the direction it provides for the increased pace and scale of restoration and fuels treatments. In other aspects of recreation settings and opportunities, access, recreation facilities, and visitor use, alternative C would result in similar benefits as alternatives B and C because it also lacks an adaptive management approach in the face of changing demands and uses placed upon recreation resources.

Scenery

Analysis and Methods

Indicators and Measures

- Acres and kind of fuel treatment to reach the desired vegetation condition that reflects the natural range of variation which leads to scenic stability and relative protection of scenic character.
- Percentage of scenic integrity objectives on each forest by scenic integrity objectives.

Methods

For comparative purposes, we mapped the desired scenic integrity objectives for alternatives B, B-modified, C, and D. The geographic information system was used to calculate the number of acres in each scenic integrity objective class. For scenic stability, we compared the amount and kind of fuel treatment needed to reach the desired vegetation condition that reflects the natural range of variation (which leads to scenic stability).

Assumptions

In the analysis for this resource, we made the following assumptions:

- Scenic integrity is maintained in places people visit and view.
- Restoration treatment of fuels (prescribed fire, mechanical treatment, wildfires managed to meet resource objectives) that moves vegetative condition toward the natural range of variation has a long-term positive effect to scenic stability ultimately sustaining scenic character, even though some short-term impacts of scenic character may occur. Mechanical treatment of fuels moves vegetative condition toward the natural range of variation faster than prescribed fire or management of wildfires to meet resource objectives and can better manage short-term impacts to scenic character. However, when combined, mechanical and fire restoration activities can move vegetation conditions towards the natural range of variation at a faster rate than either treatment type alone.
- Climate change may increase the frequency of large high-intensity wildfires or areas with high levels of insect or disease tree mortality that most likely would impact scenic character.

Affected Environment

The scenic character of the Inyo National Forest is diverse and is representative of the three major biological provinces within this area: the Sierra Nevada, the Great Basin, and the Mojave Desert. With elevations ranging from 3,800 to 14,495 feet, this shapes the scenic character of this area. The topographic relief is extreme, and 10,000 foot vertical gradients are found in the Sierra Nevada, White and Inyo Mountains. Opportunities for scenic overlooks are found throughout the area and allow visitors to experience the large expanses of undeveloped land; rare geologic formations like the Mono Craters and Obsidian Dome; wilderness areas such as the Ansel Adams and John Muir Wildernesses; and diverse ecosystems from alpine, mixed-conifer, Jeffrey pine, sagebrush steppe, to desert. Some of the most outstanding visual attractions include Mono Lake with geologic formations like tufa, and Mount Whitney, the highest peak in the continental United

States at 14,494 feet in elevation. These are areas where visitors are expected to have a high concern for scenic values and changes to scenery.

The most common developments on the Inyo National Forest that alter scenic integrity include powerlines, communication sites, substations, propane tanks, geothermal development, ski areas, hydropower facilities, reservoirs, recreation facilities, resorts, and temporary conditions like dust and smoke.

On the Inyo, many of the valued vegetation scenery attributes are at high risk of being impaired or seriously threatened due to dense vegetation conditions, ecosystem stressors such as insect and disease outbreaks, and fire return interval conditions that render landscapes susceptible to severe wildfire (see “Terrestrial Vegetation Ecology” and “Fire Trends” sections). Forest landscapes characterized by these conditions are considered to have low scenic stability. The majority of the landscapes on the Inyo includes wilderness areas and areas have high to very high scenic integrity and can be found adjacent to developed areas, such as the Town of Mammoth Lakes.

Scenery Resources

Scenic integrity plays a key role in sustainable recreation by contributing to the identity and sense of place of an area. The scenery of each national forest is a significant attraction to residents and visitors alike, creating a sense of place and a connection to the land. The magnificent vistas, meandering rivers, and forested settings are often featured by state and local tourism and marketing efforts which contributes to the economic and social sustainability of local communities. The scenic character of a national forest is a combination of physical, biological, and cultural images that give an area a visual and cultural identity. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity.

To evaluate scenery resources, the current forest plan used the Visual Management System, which was a systematic approach to inventory, analyze, and monitor scenic resources, but did not recognize or incorporate natural disturbance processes such as fire, insects, and disease. The Forest Service has been transitioning from the Visual Management System to the newer Scenery Management System, which uses different scenery evaluation terminology. A cross-walk between the two systems terminology is shown in table 81.

Table 81. Cross-walk between visual management system and scenery management system terminology

Visual Management System Terminology (Visual Quality Objectives)	Scenery Management System Terminology (Scenic Integrity Objectives)
Preservation	Very High
Retention	High
Partial retention	Moderate
Modification	Low
Maximum modification	Very Low

Scenic Character

Scenic character is defined as the combination of the physical, biological, and cultural images that give an area its scenic identity and contribute to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity.

All landscapes have definable scenic character attributes. In most national forest settings, scenic character attributes are positive natural elements such as landform, vegetative patterns, and water characteristics. In pastoral or rural settings, positive cultural elements may include historic elements such as split rail fences, stone walls, barns, orchards, hedgerows, and cabins. In urban settings, scenic character attributes may include a fabric of architectural styles. A combination of these attributes define scenic character. The concept of scenic character is embodied in the "image of an area."

Descriptions of different types of scenic character include:

- **Naturally Evolving** – Scenic character expressing the natural evolution of biophysical features and processes, with very limited human intervention. These landscapes are largely associated with wilderness areas.
- **Natural Appearing** – Scenic character that expresses predominantly natural evolution, but also human intervention including cultural features and processes.
- **Cultural** – Scenic character expressing built structures and landscape features that display the dominant attitudes and beliefs of specific human cultures. These landscapes are largely associated with areas containing recreation site development, administrative sites, or public uses under special use permits.
- **Pastoral** – Scenic character expressing dominant human-created pastures, meadows and associated structures, reflecting valued historic land uses and lifestyles. Pastoral lands also occur on private lands outside of the national forest administrative boundary, where they may be viewed while traveling on forest roads or trails.
- **Agricultural** – Scenic character expressing dominant human agricultural lands uses producing food crops and domestic products. These landscapes generally occur on private lands that are outside of the National Forest System administrative boundary, but may be visible while traveling on national forest roads or trails.
- **Historic** – Scenic character expressing valued historic features that represent events and period of human activity in the landscape.
- **Urban** – Scenic character expressing concentrations of human activity, primarily of commercial, cultural, education, residential, transportation structures, and supporting infrastructure. These landscapes generally occur on private lands, but may be visible while visiting a national forest.

Scenic Integrity

Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances from human activities or extreme natural events outside of the natural range of variation. Scenic integrity measures these disturbance effects in degrees of consistency, harmony, dominance and contrast with the valued scenic character.

Scenic integrity uses a graduated scale of five levels ranging from very high integrity to low integrity. It is emphasized within view of travelways, use areas, and special places. These levels include:

- **Very High Integrity** – The valued scenery appears natural or unaltered. Only minute visual disturbances to the valued scenery, if any, are present.

- **High Integrity** – The valued scenery appears natural or unaltered, yet visual disturbances are present; however, they remain unnoticed because they repeat the form, line, color, texture, pattern and scale of the valued scenery
- **Moderate Integrity** – The valued scenery appears slightly altered. Noticeable disturbances are minor and visually subordinate to the valued scenery because they repeat its form, line, color, texture, pattern and scale.
- **Low Integrity** – The valued scenery appears moderately altered. Visual disturbances are co-dominant with the valued scenery, and may create a focal point of moderate contrast. Disturbances may reflect, introduce or "borrow" valued scenery attributes from outside the landscape being viewed.
- **Very Low Integrity** – The valued scenery appears heavily altered. Disturbances dominate the valued scenery being viewed; and they may only slightly borrow from, or reflect, valued scenery attributes within or beyond the viewed landscape.

Many of the landscapes that include wilderness areas and areas within the primitive nonmotorized and semi-primitive nonmotorized recreation opportunity spectrum classes have high to very high scenic integrity. Common developments that alter scenic integrity include but are not limited to powerlines, communication sites, substations, propane tanks, geothermal developments, ski areas, hydropower facilities, reservoirs, recreation facilities, resorts, and temporary conditions like dust and smoke.

Scenic integrity objectives are developed in coordination with recreational settings, management direction and scenic classes. Scenic classes represent the relative landscape value by combining visibility mapping inventories and scenic attractiveness inventories. Generally, scenic classes 1 and 2 have high public value; classes 3, 4, and 5 have moderate value; and classes 6 and 7 have low value.

Scenic Stability

Scenic stability measures the degree to which the scenic character and its scenery attributes can be sustained through time and ecological progression. In other words, it looks at the ecological sustainability of the valued scenic character and its scenery attributes. Because attributes such as rock outcroppings and landforms change relatively little over time, scenic stability focuses on the dominant vegetation scenery attributes. Scenic stability recognizes major changes to the landscape that are outside of the natural range of variation, such as large wildfires and land clearing for developments, but it also includes subtle, incremental changes that can severely diminish or eliminate scenic character.

The natural range of variation can be used to assess the scenic stability of forest landscapes. This can be measured in terms of the landscape's departure from the natural range of variation. Insufficient fire or too much fire on the landscape can determine the level of departure from the natural range of variation. Departures in fire regime, insect outbreaks, and other disturbances from the natural range of variation help assess scenic stability.

Environmental Consequences to Scenery Resources

Alternatives B, B-modified, C, and D would add specific plan components relevant to scenery in the form of desired conditions, objectives and guidelines. All alternatives would help move vegetation conditions toward the natural range of variation but the amount and scheduling of restoration to move toward the natural range of variation would vary between alternatives.

Mechanical treatments for restoration may have short-term impacts to scenic integrity compared to hand treatments or prescribed fire, but over the long term, scenic character would benefit through increased scenic stability. There would be short-term scenic integrity losses with fire, but long-term potential increases in scenic integrity, especially with the reestablishment of the role of fire on the landscape. High-severity fires could cause a short-term change in scenic character and recreational value due to the fact that vegetation plays a major role in establishing and maintaining scenic character and sense of place in national forest recreation settings. Recreation settings with ecologically sound landscapes possessing diverse attributes, particularly vegetation with a composition containing a variety of species, area distribution and canopy height, have the greatest potential for high scenic value and maintaining a sense of place. High-severity fire, while providing benefits to other resources, can have a negative effect on scenic character if the result reduces the heterogeneity of the vegetation type, distribution and structural composition.

Scenic Stability and Character

Embedded within the restoration treatment discussed for each alternative is the objective SCEN-FW-OBJ-01, which focuses some fuel treatment restoration activities on recreation sites that are in areas with a high risk of large, high-intensity wildfire. This plan component helps focus restoration treatment at high-risk recreation sites to become more resilient to large, high-intensity fires, thus increasing scenic stability.

High-severity fire causes a short-term change in scenic character and recreational value due to the fact that vegetation plays a major role in establishing and maintaining scenic character and sense of place in national forest recreation settings. Recreation settings with ecologically sound landscapes possessing diverse attributes, particularly vegetation with a composition containing a variety of species, area distribution and canopy height, have the greatest potential for high scenic value and maintaining a sense of place. High-severity fire, while providing benefits to other resources, can have a negative effect on scenic character if the result reduces the heterogeneity of the vegetation type, distribution and structural composition. Scenic integrity and character would be at the greatest risk to impacts from high-severity fires under alternative A, followed by alternative C. Alternatives B, B-modified, and D provide the greatest potential to protect scenic integrity and character from high-severity fires, with D being the highest.

Consequences Specific to Alternative A

Under the existing plan, this alternative would increase scenic stability across the Inyo National Forest, which in turn improves scenic character; however it would be less than alternatives B, B-modified, C, and D. Despite some short-term impacts to scenic character, mechanical treatment achieves the natural range of variation quicker and with more precision, lessening the short-term visual impacts of treatment compared to prescribed fire or wildfire managed to meet resource objectives. This alternative has slightly less mechanical treatment than alternatives B, B-modified, and D but slightly more than alternative C. This alternative would trend vegetation toward achieving the natural range of variation but at a substantially slower rate than alternatives B, B-modified, C, and D, thus providing the lowest protection for scenic character.

Consequences Specific to Alternative B

Restoration of vegetation would occur within the montane and sagebrush systems, with the emphasis of returning these landscapes to the natural range of variation and to reduce fuels around communities and other infrastructure. These ecosystems are found within areas that have moderate to very high scenic integrity. Restoration in these areas would include slightly more mechanical treatments than alternative A, similar to alternative B-modified, more than alternative C, and just slightly less than alternative D. Prescribed fire would also be used in these areas, at a level similar to alternatives B-modified and D (estimated range overlaps completely with alternative C). Wildfires managed to meet resource objectives would also be used at a higher rate under this alternative than alternatives A and C, slightly lower than alternative B-modified, and approximately half the rate of alternative D. This activity would occur in the very high scenic integrity areas located in wilderness and would increase scenic stability by lessening the consequences of large high-intensity wildfire.

This alternative would help trend vegetation toward achieving the natural range of variation which would increase scenic stability across the landscape, and improve scenic character more than alternatives A and C, and less than alternative D.

Consequences Specific to Alternative B-modified

Consequences to scenic stability and character would be the same as in alternative B, above.

Consequences Specific to Alternative C

Under this alternative there are more acres of potentially recommended wilderness, which would increase the amount of scenic integrity in the very high and high classes. However, within these areas, management direction would be for managed wildfire to meet resource objectives, which would have a slower rate of the vegetation returning to the natural range of variability. The area may also be at risk from wildfires that burn outside of the natural range of variation or have impacts from insects and disease which may affect scenery stability over larger areas of the landscape. This increased acreage also reduces the amount of mechanical treatments that could occur, as compared to alternatives A, B, B-modified, and D. Treatment rates for prescribed fire in alternative C are highly variable (lowest level is less than anticipated under alternative A and highest level exceeds all other alternatives) but broadly similar to alternatives B, B-modified, and D. Wildfires managed for resource objectives are substantially lower than alternatives B, B-modified, and D, but higher than alternative A. Although this alternative would increase scenic stability it would be less than alternatives B, B-modified, and D.

Consequences Specific to Alternative D

In this alternative, the objective to restore vegetation conditions to the natural range of variation using mechanical treatments is slightly higher than alternatives B and B-modified. This would increase scenic stability across the landscape, particularly within the montane and sagebrush systems, at a faster rate than alternatives B, B-modified, and C, which in turn would improve scenic character. Restoration activities also include a higher use of wildfires managed to meet resource objectives, which although can restore areas to the natural range of variation, would have greater longer-term impacts to scenic integrity and take longer to achieve scenic stability than alternatives B, B-modified, and C. The use of prescribed fire would be the same as alternatives B and B-modified, therefore restoration of scenic stability would be at the same rate as those alternatives using this method of treatment.

Scenic Integrity Objectives

Future developments that have the potential to affect scenic integrity on the Inyo National Forest include powerline development and replacement, geothermal and alternative energy development, and periodic smoke and dust events. In addition, there may be potential negative short-term impacts to scenic integrity from fuel reduction restoration projects, especially those that are accomplished by mechanical means. This is primarily due to the more open vegetation on much of the Inyo National Forest and the greater visibility from high points. Short-term negative impacts would be off-set by long-term benefits where vegetation conditions are moving toward the natural range of variation to reduce impacts to scenic character from high-intensity fires and increased vegetation density caused by fire suppression.

Table 82 shows the acres and percent of the Inyo National Forest for each scenic integrity objective by alternative. The visual quality objectives for alternative A were converted to scenic integrity objectives as shown in the cross-walk in table 81. Because alternative A does not include approximately 44,600 acres of lands that were added to the Inyo National Forest from the National Forest and Public Lands of Nevada Enhancement Act of 1988, caution should be used when comparing alternative A to the other alternatives.

The table shows that alternative C would have the highest percentage of very high scenic integrity objective compared to all alternatives, mainly due to the higher acreage of recommended wilderness and increase in the Pacific Crest Trail width in this alternative. Alternative B would have a slightly higher percentage of very high scenic integrity objective compared to alternative D, mainly due to the acreage of recommended wilderness. In alternative D, those areas would be managed to meet mostly high and very high desired scenic integrity objectives. Alternative A would have the highest amount of low scenic integrity objective of all alternatives, primarily because of the difference in approaches to mapping the older visual quality objectives.

Table 82. Desired scenic integrity objectives in acres and percentage of national forest by alternative

Scenic Integrity Objective	Alternative A	Alternatives B and B-modified	Alternative C	Alternative D
Very high	751,860 37 percent	1,001,596 50 percent	1,289,968 65 percent	964,564 49 percent
High	537,540 26 percent	669,697 34 percent	450,366 23 percent	701,920 35 percent
Moderate	716,375 35 percent	301,603 16 percent	237,259 12 percent	309,412 15 percent
Low	35,470 2 percent	11,661 1 percent	9,964 less than 1 percent	11,661 1 percent
Very Low*	5 less than 1 percent	0	0	0

* Although the maximum modification objective was used in the visual management system, the current scenery management system tends to not have desired objectives for very low scenic integrity. Thus, the maximum modification/very low objective will not be compared to alternatives B, B-modified, C, and D.

Cumulative Effects for the Inyo National Forest

Areas modified by vegetation treatments, powerlines and other infrastructure would continue to appear highly managed over the next 10 to 15 years in all alternatives and scenic integrity would remain moderate to very low in those areas. Vegetation treatments and infrastructure development on adjacent private, State and Federal lands may influence overall scenic integrity. Restoration treatments across the landscape would trend vegetation toward the natural range of variation and protection of the scenic character. Driving for pleasure and other scenery dependent activities on the Inyo National Forest could be affected slightly by human disturbance to areas under other administrations. Wildfire and other disturbance processes, if large in scale and intensity, may result in lowered scenic character in those areas affected by the disturbance.

Analytical Conclusions

Change in Protection of Scenic Character based on Pace and Scale of Restoration

Alternatives B and B-modified provide the greatest protection of scenic character through the use of mechanical treatments, which are greater than alternatives A and C. Although alternative D has the greater use of mechanical treatment over these alternatives, the use of wildfires managed for resource benefit is greater, which may have longer-term effects to scenic integrity and take longer to reach scenic stability compared to alternatives B and B-modified. Alternative C would have the lowest amount of protection of scenic character as it would have the lowest amount of mechanical treatment.

Partnerships

Partnerships and volunteerism are key components of managing public lands, particularly under sustainable recreation, and they enable the Forest Service to forge valuable relationships that help to provide a means of leveraging the agency’s financial investment in recreation and management of other resources, while connecting people to the natural environment. It is generally through outdoor recreation activities, partnerships, and volunteerism that visitors interact with nature and experience the intrinsic values of the national forest. Since 1972, the Forest Service has brought in over 2.8 million volunteers, who have provided more than 123 million hours of service that is valued at about $1.4 billion.

Partnerships are an important component of sustainable recreation that management relies upon to deliver services and aid in the stewardship of the trails, recreation sites and wilderness areas, as well as other resources located on the Inyo National Forest. This section describes current partnerships on Inyo and effects to partnerships from the different alternatives.

Analysis and Methods

The analysis area for effects to partnerships includes all lands within the boundary of the Inyo National Forest. The timeframe for the environmental consequences related to partnerships is the expected life of the forest plan, or 10 to 15 years

Indicators and Measures

Indicators and measures for this analysis consist of change in partnerships and volunteer opportunities.

Affected Environment

Partnerships, volunteerism, and new management strategies have played an increasing role in maintaining and improving developed recreation facilities and trails, and restoring and rehabilitating landscapes on the Inyo National Forest. Nonprofit organizations help remove graffiti and trash, and provide visitor information and interpretive programs along river corridors, popular dispersed recreation sites, and developed recreation sites. These partnerships and agreements are often made possible with funding from sources such as off-highway vehicle green sticker funds, resource advisory council grants, the Federal Lands Recreation Enhancement Act, stewardship councils, and other sources that supplements appropriated dollars. These partnerships are critical to helping the Inyo meet current and future public demands for high quality recreation experiences. Partnerships and volunteer programs help mitigate many of the negative impacts of unmanaged recreation and improve the Inyo’s ability to deliver high-quality sustainable recreation.

Concessionaires (private businesses that operate and maintain government recreation facilities under a special use permit) operate approximately 70 developed family campgrounds, as well as group campgrounds, day use facilities, and cabin rentals. The Federal Lands Recreation Enhancement Act has increased the funds available for some recreation facilities and opportunities that the Forest Service manages. Under this Act, the Forest Service collects use fees at 10 campgrounds and 3 day-use sites on the national forest. The fees collected at these sites help provide services and make improvements that benefit the visitors who pay these fees.

Under the current forest plan, partnerships, volunteers, grants, and agreements help maintain and improve developed recreation facilities and trails on the Inyo National Forest. Most developed campgrounds and fee day-use sites are managed under a concessionaire contract. Some sites and facilities not under concessionaire management have partnership agreements with local non-profit organizations and user groups. These partnerships, volunteers, and agreements assist with maintenance on motorized and nonmotorized trails, wilderness patrols, and facilities operation and maintenance. Non-profit organizations help remove graffiti and trash, and provide visitor information and interpretive programs along river corridors, popular dispersed recreation sites, and developed recreation sites. These partnerships and agreements are often made possible with funding (such as green sticker funds, resource advisory council grants, the Federal Lands Recreation Enhancement Act, stewardship council, and other sources) that supplements appropriated dollars.

The Inyo National Forest has outfitters and guides, organizational camps, and special recreation events that operate under special use permits to provide recreation opportunities to the public. The level of facilities and programs currently available to the public are dependent on these partnerships with commercial and private operators. Under the Recreation Enhancement Act, 90 percent of the fees collected from outfitters and guides and for special recreation events are returned to the Inyo National Forest to provide and improve the recreation experience of visitors.

Partnerships and volunteerism also play an important role in maintaining and restoring trails, and rehabilitating landscapes and watersheds on the Inyo National Forest. Between 2010 and 2015, Inyo National Forest partners and volunteers contributed 203,787 hours; of those, 94,119 were wilderness and nonwilderness trail maintenance, and 4,479 hours were trail restoration and rehabilitation. Partners and volunteers play an important role in maintaining trails as well; with the assistance of partners and volunteers, the Inyo National Forest was able to maintain approximately 579 miles of trails in 2015.

Environmental Consequences to Partnerships

Consequences Specific to Alternative A

Under the current forest plan, partnerships, volunteers, grants, and agreements would continue to help maintain and improve developed recreation facilities and trails on the Inyo National Forest. Existing partnerships and volunteers would be expected to continue at current levels under alternative A. New partnerships would be created as staffing to manage volunteers would allow.

Consequences Common to Alternatives B, B-modified, C, and D

A significant emphasis was placed on volunteers and partnerships in the revised plan. The revised plan alternatives contain components in the form of desired conditions and goals to provide direction on partnerships and volunteers.

Given the increased emphasis on creating and maintaining successful partnerships in the revised plan, all plan revision alternatives would have an overall increase in partnership opportunities over alternative A. The Inyo National Forest would also have a greater staffing capacity to create and foster successful partnerships which would likely create additional partnership opportunities.

Partnerships, volunteerism, and grants and agreements that help maintain or improve developed recreation facilities would likely increase in all plan revision alternatives due to the increased management emphasis focused on partnerships and volunteers.

Consequences Specific to Alternatives B and B-modified

Under alternatives B and B-modified, there would be four new recommended wilderness areas. The wilderness polygons do not include any system motorized roads or trails; therefore, existing partnerships centered on motorized use would likely not be affected and even increase over alternative A. There would be an increased opportunity for partnerships and volunteerism focused on wilderness stewardship and trails in the new recommended wilderness areas, but less than alternative C with 24 recommended wilderness areas.

Specific to alternative B-modified, under this alternative conservation watersheds would likely provide an increase in partnerships opportunities with fish and wildlife groups.

Consequences Specific to Alternative C

There are 24 new recommended wildernesses areas in alternative C, which could likely increase partnership opportunities focused on wilderness stewardship and nonmotorized opportunities to a greater extent than B and B-modified because it has the greatest number of recommended wilderness areas. The wilderness polygons do not include any system roads or trails similar to alternatives B and B-modified; however, with the greatest decrease in motorized settings, it is possible motorized partnerships could decrease in this alternative. Mechanized transport (mountain bike use) would not be suitable on 43 miles of trails that currently allow bicycles in this alternative, which could potentially cause a decrease in existing and future partnerships by groups focused on mechanized use. However, it is also possible that partnerships with mechanized groups and volunteers could shift to other locations on the Inyo National Forest, thereby not causing a decrease in mechanized partnerships.

Consequences Specific to Alternative D

This alternative would likely have similar levels of partnership opportunities to alternatives B and B-modified, except without any recommended wilderness areas, the partnership opportunities with wilderness based groups would have less potential to increase than alternatives B, B-modified, and much less than alternative C. The pace and scale of ecologic restoration may have potential to decrease partnerships and volunteerism in the short term depending on location and type of treatment, but there would still be an overall increase in long term partnership opportunities so this is considered a negligible .

Analytical Conclusions

Table 83 shows a comparison of changes in partnership and volunteer opportunities across all alternatives. Under alternative A there would be no change in partnerships or volunteerism. Existing partnerships would likely continue and new partnerships would be considered as staffing and resources allow. Partnership and volunteer opportunities related to wilderness stewardship would increase under alternatives B and B-modified, and to the greatest extent in alternative C.

However, under alternative C, there is less potential for an increase in mountain bike and motorized related partnerships than alternatives B, B-modified, and D because of the decrease in motorized settings and mechanized trails. There would be an overall increase in partnership and volunteer opportunities in all plan revision alternatives over alternative A, but it is likely that the greatest increase in partnership opportunities would occur under alternative B-modified because of the partnership opportunities within new recommended wilderness areas and conservation watersheds.

Table 83. Comparison of indicator by alternative

Indicator	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Change in partnerships and volunteer opportunities	No change. Existing partnerships expected to continue at current levels with new new partnerships considered as staffing and resources allow	Partnership opportunities expected to increase; higher potential increase in wilderness-based partnerships than alternative D, but less than alternative C	Similar to alternative B, except conservation watersheds in B-modified would provide highest level of partnership opportunities with fish and wildlife groups	Partnership opportunities expected to increase; highest potential for increase in wilderness-based partnerships, but less potential increase in mountain bike and motorized related partnerships than alternatives B, B-modified and D	Partnership opportunities expected to increase; less potential for an increase in wilderness-based partnerships than alternatives B, B-modified, or C

Heritage Resources

Background

This section summarizes the current heritage resources environment on the Inyo National Forest and the potential consequences to heritage resources from the draft forest plan and alternatives.

Heritage resources (also sometimes referred to as “cultural resources”) are an object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Heritage resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties. Heritage resources include the entire spectrum of resources for which the Forest Service is responsible, from artifacts to cultural landscapes without regard to eligibility for listing on the National Register of Historic Places. These resources represent past human activities or uses and, by their nature, are considered an irreplaceable and nonrenewable resource if not managed for preservation over the long term.

Because heritage resources represent important cultural values, they are of special concern to the public. Interest in our heritage and concern over the destruction of archaeological sites has prompted the passage of national, state, and local levels of legislation that are designed to promote and protect these examples of our Nation’s historical and traditional legacy. As a result, a variety of laws, regulations, and policies provide direction for managing and protecting heritage resources on National Forest System lands. This guidance is independent from forest plan direction and does not change across alternatives.

Every endeavor that results in ground disturbance or brings an increase of public or agency use has the potential to affect heritage resources. Activities that disturb the ground include such things as digging postholes for sign placement, timber harvest, constructing a new bathroom, enhancing a campground, laying fiber optic cable, large scale vegetation management, or fire prevention and suppression activities. In addition, projects may have indirect effects on areas of the landscape that are important for cultural and tribal values. The consequences to Tribes and tribal resources are discussed separately in the "Tribal Relations and Uses" section.

The Forest Service Heritage program has operated under the premise of "flag and avoid" heritage resources during project implementation for years. A flag-and-avoid strategy works for protection of heritage resources on "small foot-print" types of projects because scheduling and heritage staff can be made available to accomplish compliance with section 106 of the National Historic Preservation Act. It is difficult and costly to implement for large landscape scale projects and has led to the conundrum the Inyo National Forest now faces regarding heritage resources and project implementation. Sites that have been "flagged and avoided" usually have not been evaluated; thus until evaluated, they must be treated as if they are historic properties eligible for listing on the National Register of Historic Places. This presents a major management challenge given the number of sites already known and the increased numbers that will be discovered during surveys as larger landscape areas are being evaluated for restoration projects. Having to manage resources that may not be eligible for listing on the National Register of Historic Places, takes away valuable staff time which could be better spent on managing and monitoring those resources that are listed or eligible for listing, inventorying areas that have not been previously surveyed for heritage resources and providing recordation and evaluation for newly identified heritage assets.

Analysis and Methods

It is not possible to evaluate the impacts of the alternatives on specific heritage sites because a high percentage of known sites have not been evaluated and because the draft forest plan is programmatic in nature. Instead, the analysis is based on considering the amount of potential ground disturbance as a proxy for the potential for impacts to heritage resources.

Indicators and Measures

The amount of ground disturbance that might occur under each alternative is used as an indicator because of the potential for ground disturbance to adversely affect heritage resources. This is complicated by the fact that the total occurrences of cultural sites are unknown due to the lack of complete survey and inventory on the Inyo National Forest.

Affected Environment

Heritage resources on the Inyo represent a diversity of cultures and their uses of the landscapes, including native people, colonial California, late 19th and 20th century state history (such as the Gold Rush) and American history, Civilian Conservation Corps history, and Forest Service history.

The plan area has at least a span of 9,000 years of human occupation and use. People arrived in California more than 13,000 years ago (Johnson et al. 2002). The exact date of Native American arrival is unknown. Occupation of the lower southern Sierra Nevada foothills began prior to 9,000 years ago and would have been limited in many locations due to high-elevation glaciation. As the climate and resource availability changed so did the people as they adapted to changing environmental conditions and the distribution of plants and animals used for sustenance and shelter. Archaeological research within the national forest is limited but a chronological sequence of cultural transitions in adjacent areas is applicable as described below from McGuire and Garfinkle (1980).

Prehistoric and Historic Periods

Paleoindian Period (9,000 to 6,000 years ago)

Most prehistoric sites on the national forest from this time period would have been associated with trans-Sierran travel and trade or seasonal big game hunting. Most prehistoric use of the land within the plan area during this period appears to have been pass-through travel or seasonal resource extraction. Generally, the Inyo was only used sporadically by nomadic groups during the Paleoindian period.

Lamont Phase or Little Lake Period (6,000 to 3,200 years ago)

This was a dry time with sites located on ridges, saddles, and along meadow margins. Visits to the plan area were sporadic and associated with plant collecting and big game hunting. During the warm dry time, it is postulated that the stands of pinyon pine shifted and expanded providing additional plant foods for foraging peoples. Obsidian and other stone tool materials are common to this period.

Canebrake Phase or Newberry Period (3,200 to 1,400 years ago)

This time period saw a tremendous increase in Native American use of the pinyon pine stands and other plant foods. Milling equipment increased in both quantity and variety. Obsidian quarrying in the eastern Sierras intensified. Stone tool point styles were more varied and diverse. The spear and atlatl were the primary hunting weapons, as they were during the Paleoindian period. While populations remained highly mobile, a pattern of returning use began to emerge with suggestions of a more permanent settlement pattern becoming established throughout the lower western Sierra foothills. The first signs of intensive occupation are found in ecological boundary areas rich in plant and animal resources, such as the Kern River Valley.

Sawtooth Phase or Haiwee Period (1,400 to 700 years ago)

During this time there was a tremendous increase in the number and diversity of archaeological sites over the entire landscape. The number of people living and traveling through the national forest increased exponentially as the bow and arrow, a much superior weapon, replaced the spear as the hunting tool of choice. Large mammals such as mule deer, pronghorn and bighorn sheep were hunted, as were smaller mammals such as rabbits, hares and rodents. The development of the ubiquitous bedrock mortar and pestle, and milling and grinding slabs across the landscape indicate the importance of plant foods such as acorns, seeds, pine nuts, grasses and forbs. Wetlands and waterfowl were also important. Populations appeared less mobile, with favored food processing locations revisited again and again over many millennia, resulting in the development of deeply stratified archaeological sites. The appearance of Olivella beads at sites east of the Sierra suggest the beginning of trade networks stretching to the California coast, and there is some discussion of a possible major emigration of people into the Great Basin from southeastern California.

Chimney Phase or Marana Period (700 years ago; the historic period)

Subsistence strategies during this period were diverse and intensive, with resources from a large number of ecological zones used, including wetlands, desert sage communities, upland and montane environments, tablelands, and pinyon groves. Pottery use began and an increase in shell and steatite beads at sites in the eastern Sierra foothills suggest there were robust trade networks. Clearly defined house pits point to increased levels of permanent settlement.

At the time of European incursion, the foothills and river valleys on the west side of the Sierra Nevada range were some of the most densely populated areas in North America. Sites recorded today document large semi-permanent villages, house pits, formal cemeteries, pottery, soapstone bowls and decorative objects, rock art. Villages were being reused, populations were increasing in size, ceremonial areas developed, and long distance trade networks existed that imported trade goods from over long distances.

Historic Period (400 years ago; the present period)

The introduction of European diseases decimated more than 95 percent of the indigenous peoples and they were later displaced by miners, ranchers, and other early pioneers. Mines, ranches, built towns, and engineered roads were built over many of the old traditional Native settlements. Tribal people adapted and changed and accepted paid employment in the mines and on the ranches as the landscape evolved with new settlers. Many traditional peoples were displaced as large segments of land were allocated to Government ownership and active stewardship by Government managers. Administrative Government facilities were built along the trails and adjacent to key mining and grazing areas. The rivers were dammed to provide hydroelectric power to the growing urban areas in California. Dams, flumes, tunnels, company towns, construction camps, railroads and all manner of facilities associated with hydroelectric power generation began to be built within the plan area in the early teens of the 20th century. Timber harvest increased in the early 1900s. The intensity and extent changed as new methods and machinery were developed, starting with logging by horses and mules. The development of steam equipment led to more road building and eventually to railroads to meet the demands of growing populations in towns and cities. Modern log trucks and heavy equipment allowed access to more areas and replaced railroads and created the foundation for many of the current road systems on the national forest. Recreational interest and use of the Inyo became important as motor vehicles developed and flourished. Campgrounds, recreation residences, resorts, and organizational camps expanded throughout the national forest.

Cultural Resources Surveys

The prehistoric Native American past is embodied in the rock art and prehistoric archaeological sites that range in size from small stone tool scatters to large villages occupied for hundreds of years that dot the contemporary landscape. These sites are highly valued by local Tribes as the very embodiment of their past and the places where their ancestors lived, worshiped, and died. It is a tangible link to a very long history but despite their persistence through time, sites are extremely vulnerable to damage by ground-disturbing activities and even from high-intensity fire. Prehistoric Native American sites are also vulnerable to illegal looting and illicit excavation.

Historic period sites are also extremely vulnerable to destruction by disturbing activities including wildfire; especially wooden cabins, flumes, lookouts and old mine buildings. Looting of historic artifacts at historic sites is as much of a problem as that on deeply buried Native American sites.

The presence of prehistoric and historic sites reflects the human use of the approximate 2 million acres encompassing the Inyo National Forest. The total extent of the heritage resource database for the Inyo has not been determined. However, from an evaluation of survey data, it is estimated that approximately 11 percent of the Inyo National Forest has been inventoried for heritage resources. Most of these surveys have been project-specific rather than large-scale or systematic surveys.

Heritage surveys have identified a total of 5,405 sites on the Inyo National Forest. Table 84 displays the number of identified heritage resources on the Inyo National Forest by site type. Of those totals, 83 percent of the sites on the Inyo remain unevaluated for the National Register of Historic Places. This means that all unevaluated sites are considered to be eligible properties for listing on the National Register of Historic Places and must be managed as such until an eligibility determination is submitted to the Office of Historic Preservation for the State Historic Preservation Officer's concurrence; or it must be submitted directly to the Keeper of the National Register for a determination.

Table 84. Number of heritage sites by type

Type of Site	Number
Prehistoric	2,386
Historic	762
Multi-Component	160
Unidentified	2,097
Contemporary	0
Protohistoric	0
Total Sites	**5,405**

Table 85 summarizes the numbers of site evaluations and designations on the Inyo National Forest that have undergone evaluation. Of those evaluated, 73 percent of the evaluated sites on the Inyo National Forest were found to be not eligible for listing on the National Register of Historic Places. Given that only a small portion of the known heritage sites have been evaluated, the Inyo NF is currently managing potentially non-eligible heritage resources, all of which need to be considered as eligible during the planning process and avoided.

Table 85. Number of heritage site determinations and number of historic landmarks under the National Register of Historic Places (NRHP)

Heritage Site Determinations	Number
NRHP Listed	0
National Historic Landmark	0
State Historic Landmark	0
NRHP Eligible	249
Not Eligible	688
Total Determinations	937
No Determination	4,468

Environmental Consequences to Heritage Resources

Nearly every action undertaken by the Forest Service has the potential to affect heritage resources either directly or indirectly. Not all effects are necessarily adverse and some effects may be avoided either through project design or the implementation of standard protection measures as outlined in appendix E of the Programmatic Agreement with the California and Nevada State Historic Preservation Officers and the Advisory Council on Historic Preservation (USDA FS 2013).

Heritage resources are nonrenewable and any effect can result in the unacceptable destruction or damage to examples of the area's heritage. Heritage resources also need to be reviewed not only as individual resources, but holistically at larger landscape levels. What may appear to be individual sites, or dots on a map may very well be historic districts (for example, mining complexes, ranching complexes; or cultural landscapes) that include village sites with surrounding special use areas containing trails, plant gathering areas, lithic quarries, and other essential resources.

Consequences Common to all Alternatives

Regardless of the alternatives, all site-specific projects would consider effects to heritage resources at the outset of every project planning process. Compliance with section 106[39] of the National Historic Preservation Act of 1966 as amended would be completed prior to making a decision to implement a project, approve a permit, or undertake an activity. The section 106 process may be completed by consultation with the State Historic Preservation Officer, Tribes, the public, and other stakeholders, and at times with the Advisory Council on Historic Preservation using the regulatory process codified at 36 CFR Part 800 as amended or through implementation of the stipulations of the Region 5 Programmatic Agreement (USDA Forest Service and CA SHPO 2013).

All alternatives include direction to reduce fuels and restore fire to the landscape, but using different approaches and with a different pace and scale of restoration. The extent that each alternative reduces the extent and severity of wildfires would reduce the risk of inadvertent impacts to heritage sites from fire suppression activities and from damage from high soil heating.

Consequences Common to Alternatives B, B-modified, C, and D

The emphasis on variable treatment intensities and on restoring and managing for vegetation heterogeneity in alternatives B, B-modified, C, and D should provide opportunities to design projects around small sites to minimize or avoid disturbances to heritage resources. Avoidance would follow the standard practice of using the "flag and avoid" strategy, but would also encourage designing projects to reduce threats to heritage resources from large high-intensity wildfires by allowing low-intensity treatments around small sites to promote an increase in resilience and sustainability of forests. A plan objective (CULT-FW-OBJ-01) focuses on increasing the number of sites managed and monitored that are listed or eligible for listing, increasing the areas inventoried that have not been previously surveyed for heritage resources and increasing recordation and evaluation for newly identified heritage assets.

[39] Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.

Management activities (such as mechanical thinning, prescribed burning, and managing wildfires to meet resource objectives), appropriately implemented so as to avoid direct and indirect effects to heritage resources and tribal values, may afford greater protection compared to consequences from continued forest growth and density increases that lead to larger and higher intensity wildfires. Activities associated with wildfire suppression under emergency conditions often have adverse impacts to heritage resources, such as running a dozer line through sites and areas sensitive to Tribes.

Alternatives B, B-modified, C, and D encourage managing wildfires to meet resource objectives, especially in the wildfire maintenance zone. Some wildfires are also managed to meet resource objectives in alternative A in wilderness and remote areas. Decisions to manage wildfires and on-the-ground activities while managing wildfires would consider the location of known sites and where possible, resource advisors would be consulted to develop strategies to minimize or to mitigate impacts. The desired outcome is to restore fire to the landscape similar to conditions that have occurred historically such that the impacts to sites would not be substantially different than they have been exposed to for centuries. There is some additional opportunity in alternatives B, B-modified, and D which are discussed separately for those alternatives.

Consequences Specific to Alternative A

Alternative A represents the existing plans (as amended) and would have no measurable direct effects on any known heritage resources from continuing activities currently allowed under the existing plan. This is because planned projects involving ground-disturbing activity would either avoid direct and indirect effects to heritage resources or would include project-specific mitigation measures to address any adverse effects to specific heritage resources by reducing them to acceptable levels or following existing processes when effects cannot be adequately mitigated.

During wildfires, there are risks to sites and resources from fires that burn at high intensity with heat pulses into the soil that can damage individual resources and threaten sites where high-intensity fires result in surface erosion and the movement of soils and the rearrangement of sites. In some cases, high-intensity fire can ruin the ability to date some artifacts, especially obsidian, by changing the hydration bands. Fire can also burn wood or natural fiber artifacts.

Consequences Specific to Alternatives B and B-modified

Alternatives B and B-modified emphasize ecological fire resilience and restoration of fire as an ecosystem process with a greater focus on large-scale landscape level projects. There would be more mechanical thinning treatments and more prescribed burning than alternative A. As only 11 percent of the Inyo National Forest, 13 has been inventoried for heritage resources, a large-scale on the ground effort would be needed to identify heritage resources in previously unsurveyed areas. Known sites that are unevaluated are managed as if they were eligible for listing on the National Register of Historic Places resulting in the need to include additional mitigation measures when designing projects. Vegetation treatment measures that emphasize low-intensity fire, and increased use of hand treatment in and around known sites would lower the potential for adverse impacts to heritage resources. Prescribed burning can be compatible with heritage sites and heritage resources if the fire can burn at low intensity or with mitigations to protect them such as constructing fire lines to exclude fire or covering or protecting features to reduce the risk of ignition.

Alternatives B and B-modified recommend additional wilderness on the Inyo National Forest, which could reduce the risk of direct human impacts to more known and unknown sites. Sites located within designated wilderness and areas recommended as wilderness would benefit from the restrictions on motorized use and restrictions on mechanical vegetation treatments but may be negatively impacted by continuing fuel accumulations and the risks associated with fires that burn at high intensity.

Alternatives B and B-modified emphasize restoring fire to the landscape, which would include a consideration of heritage resources in determining where and how it can be used to meet resource objectives. This would benefit heritage resources by reducing fuels while reducing impacts by managing the intensity of fire. Projects would be designed to avoid and minimize impacts and effects to heritage sites and to indirectly improve the resilience of sites by reducing threats from fire and other uses Treatments along strategic roads and ridgetops, especially in the wildfire restoration zone are expected to increase the potential to manage wildfires in this zone over time, further reducing the risk of high-intensity fire impacts to heritage sites.

Consequences Specific to Alternative C

Alternative C places an emphasis on providing more short-term protections for wildlife habitat. This alternative proposes to add the most areas recommended for wilderness designation of all the alternatives. Additionally, this alternative has more areas with restrictions or limitations on the intensity and extent of treatment using mechanical vegetation management methods, which would afford greater short-term protection by resulting in less impacts to known and unknown heritage resources. Conversely, those restrictions and protection measures could have more indirect effects by leaving more areas with levels of surface fuels outside the natural range of variation which could damage sensitive sites and resources if they burn at high intensity in wildfires. Alternative C emphasizes more use of prescribed burning in lieu of mechanical treatments where possible. As described for alternative B, prescribed burning can be compatible with heritage sites and heritage resources, but careful planning is needed, especially where fuels are heavy and there is no mechanical pre-treatment to reduce them prior to burning. Some work by hand or to remove small-diameter trees and other vegetation may occur, but the extent would be limited by funding. Most prescribed burning would need to be designed in existing heavy fuel conditions which may mean some burns would become backlogged if suitable conditions for a favorable burn outcome do not occur as frequently due to climate change with drier spring conditions and longer fire seasons into the fall.

Consequences Specific to Alternative D

Alternative D has the greatest increase in the pace and scale of ecological restoration that could involve ground-disturbing activities. Given the increase in development, such as the increase in recreation opportunities and the increase in the scale of treatments, the need for project-level survey and design mitigations would be the greatest in this alternative compared to the other alternatives. There is some uncertainty in how project planning may need to change to ensure surveys do not become obstacles to achieving the increased amount of restoration in this alternative.

Alternative D would have similar effects and benefits as described for alternatives B and B-modified. The increase in area of mechanical treatments with greater fuel reductions would require more coordination and consultation to design projects to avoid and minimize impacts and effects, but would result in a greater reduction in the potential for large high-intensity fires. Alternative D would have the most ability, primarily through increased stewardship funding opportunities, to do additional preparatory work, including evaluation of sites, to mitigate impacts and to avoid and minimize the potential for impacts to heritage sites and heritage resources during mechanical treatments and prescribed burning.

Cumulative Effects

Direct and indirect effects are considered to be adverse when the project or action may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register of Historic Places in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects to a historic property may also include reasonably foreseeable effects caused by the project or action that may occur later in time, be farther removed in distance or be cumulative. Examples of adverse effects are effects that change the character of the property's use or of physical features within the property's setting that contribute to its historic significance; removal of the property from its historic location; or, the introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features. Because all Federal agencies must comply with section 106 of the National Historic Preservation Act, similar management approaches are used on lands managed by the National Park Service and Bureau of Land Management.

Cumulative effects are difficult to evaluate because of the large proportion of known sites that have not been evaluated. The Inyo manages for "no effect" or "no adverse effect" to heritage resources for all planned management activities, which lessens the risk of cumulative effects by presuming known sites are eligible for inclusion in the National Register of Historic Places and protecting them. Some project activities may result in unplanned or inadvertent adverse impacts to heritage resources. Such unplanned or inadvertent adverse impacts are addressed and mitigated on a case-by-case basis through consultation with the State Historic Preservation Officer, tribal partners, other interested parties, the public, and at times the Advisory Council on Historic Preservation. Heritage resources are non-renewable resources and the destruction or damage to them cannot be reversed. The alternatives all have a restoration component, but care must be taken to protect significant heritage resources, such as prehistoric and historic sites, traditional cultural properties, traditional gathering and use areas, sacred sites and landscapes, archaeological and historic districts.

Analytical Conclusions

At the project level, all of the alternatives have the potential to impact heritage resources given that less than 12 percent of the plan area has been systematically inventoried for heritage resources and that 83 percent of all known recorded sites remain unevaluated for the National Register of Historic Places. A "flag-and-avoid" strategy works for protection of heritage resources on "small foot-print" types of projects because scheduling and heritage staff can be made available to accomplish compliance with section 106 of the National Historic Preservation Act. It becomes more problematic with larger landscape scale projects encompassing thousands of acres because of the unknowns relating to heritage resources. Large-scale projects generally have to be phased in terms of section 106 compliance, or the use of predictive modeling could be employed to assist with informing on the "likely" location of heritage resources, with an outcome for an increase in unplanned or inadvertent effects to known or unknown heritage resources.

Alternative A would continue a slow rate of restoration that is suitable for continuing a "flag and avoid" strategy but leaves much of the national forest and heritage resources at risk of damage from high-intensity fires. Alternative C would reduce the amount of restoration accomplished using mechanical methods which would reduce the potential for direct impacts to heritage resources. Alternative C would use more prescribed fire but less mechanical pre-treatment of fuels, which would require careful planning to avoid burning at high intensity where fuels are heavy. Alternatives B, B-modified, and D strive to balance the greater risks of impacts to heritage sites by increasing the amount of mechanical thinning treatments and the amount of prescribed burning that would restore vegetation conditions and lower the risk of large, high-intensity wildfires over time. This would benefit heritage resources that would be damaged by fires that burn at high intensity.

Designated Wilderness

Background

The Wilderness Act of 1964 requires the preservation of wilderness character and recognizes multiple values and public benefits found in these areas. Wilderness provides outstanding opportunities for solitude and for primitive and unconfined recreational experiences. Wilderness is also important for maintenance of species diversity, protection of threatened and endangered species, protection of watershed, scientific research, and various social values.

Analysis and Methods

The analysis area for effects to existing designated wilderness includes the nine existing designated wildernesses on the Inyo National Forest. The timeframe for the environmental consequences related to existing designated wilderness areas is the expected life of the forest plan, or 10 to 15 years.

Indicators and Measures

There is one indicator for existing designated wilderness in this analysis: Protection of wilderness character.

Methods

This analysis includes a qualitative discussion of the effects of the proposed management direction in the different alternatives on the existing designated wilderness areas and recommended wilderness areas. Wilderness character, the Inyo's ability to manage recommended wilderness, the Inyo's ability to conduct fuels, fire and wildlife habitat management, and any change in the miles of system trails that allow mechanized transport within areas recommended for wilderness are all used to measure the effects of each alternative.

Wilderness Character

The Wilderness Act, section 4(b) indicates each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area. The Forest Service has identified five "qualities" that are used to assess wilderness character from the statutory language of the Wilderness Act (Landres et al. 2011): natural quality; undeveloped quality; untrammeled quality; opportunities for solitude or primitive and unconfined recreation; and other features of value described as follows (see appendix B in volume 2 for the evaluation of the wilderness characteristics of each recommended area).

Natural Quality: This quality pertains to terrestrial, aquatic, and atmospheric resources, and ecological processes. The natural qualities of wilderness for this analysis are based on the concepts of naturalness discussed in Cole and Yung (Cole and Yung 2012), and the discussion on ecosystem connectivity and diversity contained in "Chapter 1: Terrestrial, Aquatic, and Riparian Ecosystems" of the Inyo Final Assessment (USDA Forest Service 2013a). The natural quality of wilderness is protected to the extent biological diversity and ecological resilience is sustained, ecosystem structure and function is maintained, and natural disturbance processes are sustained.

Undeveloped quality: This quality pertains to whether wilderness is essentially without permanent improvement or modern human occupation. This quality is influenced by what are commonly called the "section 4c prohibited uses;" that is, the presence of modern structures, installations, habitations, and use of motor vehicles, motorized equipment, or mechanical transport.

Untrammeled quality: This quality pertains to whether wilderness is essentially unhindered and free from the actions of modern human control or manipulation. This quality is influenced by any activity or action that controls or manipulates the components or processes of ecological systems inside the wilderness.

Opportunities for solitude or a primitive and unconfined type of recreation: This quality pertains to whether visitors can find opportunities for solitude in wilderness, or to engage in primitive-type or unconfined recreation activities.

Other Features of Value: A wilderness may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value" that occur only in specific locations and are unique to an individual wilderness. Features of value may be identified in the law that designates a wilderness or through the Congressional legislative history, and are not present in every wilderness.

Affected Environment

There are currently three groups of contiguous wilderness located on the Inyo National Forest. The first group in the central and southern Sierra Nevada Mountains includes five wilderness areas with a combined size (managed by the Inyo) of approximately 632,059 acres. This group of wilderness areas is notable for being part of the second largest contiguous block of wilderness in the continental United States when combined with the other wilderness areas located on the Sequoia and Sierra National Forests. The second group is in the Basin and Range Province. This group includes two contiguous wilderness areas and the Ancient Bristlecone Pine Forest, with a combined size of approximately 260,500 acres. The Ancient Bristlecone Pine Forest is included with the wilderness areas in this group because it is a congressionally designated area where all natural features are protected. The third group is also in the Basin and Range Province and includes one wilderness contiguous with a large portion of the Death Valley Wilderness.

Existing Designated Wilderness Areas

Designated wilderness comprises almost 46 percent of the Inyo National Forest, for a total of 964,360 wilderness acres. There are nine designated wilderness areas, either in whole or part, within the administrative boundary of the national forest.

General direction for management for all wilderness areas on the Inyo is contained within the existing land management plan, which specifies that the Inyo should "maintain a predominantly natural and natural-appearing environment, facilitate low frequencies of interaction between users, and exercise necessary controls primarily from outside the wilderness boundary" (USDA Forest Service 1988a).

Detailed direction for managing the Ansel Adams, Golden Trout, Hoover, and John Muir wilderness areas is currently provided by wilderness-specific management plans. The wilderness-specific management direction for each of these areas.

A trailhead quota system currently manages use within the Ansel Adams, Golden Trout, and John Muir Wilderness areas, but not any of the other wilderness areas. Wilderness permits are not required for day use, except on the Mount Whitney Trail in the John Muir Wilderness.

Table 77 displayed in the “Sustainable Recreation and Scenery” section, shows the total number of estimated wilderness visits on the Inyo National Forest based upon the most recent National Visitor Use Monitoring data from 2006 and 2011. The survey data show that wilderness visitation on the Inyo nearly doubled from 2006 to 2011; in 2006, designated wilderness estimated visits were 138,000 and in 2011 the estimated wilderness visits were 252,000 (USDA Forest Service 2006 and 2011b).

The following lists existing wilderness areas located on the Inyo National Forest (or adjacent if they are pertinent to this analysis), their size, whether they are jointly administered by other agencies, and prominent areas that lie along their boundaries. Maps of each wilderness area are located in volume 4.

- **Ansel Adams Wilderness**: The Ansel Adams Wilderness is 231,279 acres and is jointly administered by the Inyo National Forest (78,710 acres), the Sierra National Forest (152,569 acres), and Devil’s Postpile National Monument (747 acres). It is contiguous with Yosemite National Park along its northern boundary, the John Muir Wilderness along its southern boundary, and the Owens River Headwaters Wilderness along its eastern boundary.
- **Boundary Peak Wilderness:** The Boundary Peak Wilderness is 10,518 acres solely administered by the Inyo National Forest. It is contiguous with the White Mountains Wilderness along its western boundary.
- **Golden Trout Wilderness**: The Golden Trout Wilderness is 303,511 acres and is jointly administered by the Inyo National Forest (193,630 acres) and the Sequoia National Forest (110,746 acres). It is contiguous with the John Muir, Sequoia-Kings Canyon, and John Kreb Wilderness Areas along its northern boundary, and the South Sierra Wilderness along its southern boundary.
- **Hoover Wilderness:** The Hoover Wilderness is 128,000 acres and is jointly administered by the Inyo National Forest (28,619 acres) and the Humboldt-Toiyabe National Forest (99,381 acres). It is contiguous with Yosemite National Park along portions of its southwestern boundary.
- **Inyo Mountain Wilderness:** The Inyo Mountain Wilderness is 198,874 acres and is jointly administered by the Inyo National Forest (74,512 acres) and the Bureau of Land Management (124,362 acres). It is contiguous with the Death Valley Wilderness along portions of its eastern boundary.
- **John Muir Wilderness**: The John Muir Wilderness is 651,992 acres and is jointly administered by the Inyo National Forest (325,315 acres) and the Sierra National Forest (326,677acres). It is contiguous with the Ansel Adams Wilderness along its northern boundary, the Dinkey Lakes, and Sequoia-Kings Canyon Wildernesses along its western boundary, and the Golden Trout and Monarch Wildernesses along its southern boundary.

- **Owens River Headwaters Wilderness:** The Owen River Headwaters Wilderness is 14,725 acres administered by the Inyo National Forest. It is contiguous with the Ansel Adams Wilderness along its southwestern boundary.
- **Piper Mountain Wilderness**: The Piper Mountain Wilderness is 72,192 acres and is administered by the Bureau of Land Management (BLM). Although it is not within the boundaries of the Inyo NF, it is part of the wilderness section because it borders a recommended wilderness area (Piper Mountain Wilderness Addition) proposed in alternatives B, B-modified, and C.
- **South Sierra Wilderness**: The South Sierra Wilderness is 60,084 acres and is jointly administered by the Inyo National Forest (31,582 acres) and the Sequoia National Forest (28,502 acres). It is contiguous with the Golden Trout Wilderness along its northern boundary and is separated only by a narrow road corridor from the Domeland Wilderness.
- **White Mountains Wilderness**: The White Mountains Wilderness is 230,958 acres in size, and is jointly administered by the Inyo National Forest (206,756 acres) and the Bureau of Land Management (24,202 acres). It is contiguous with the Boundary Peak Wilderness along its northeast boundary.

Environmental Consequences to Existing Designated Wilderness

Consequences Specific to Alternative A

Under alternative A, the existing forest plan would continue to guide management of existing wilderness areas on the Inyo National Forest (USDA Forest Service 1988a). General management direction exists but many designated wilderness areas have wilderness management plans that provide more specific management guidance.

Existing forest plan direction would continue to protect and maintain the five qualities of wilderness character in designated wilderness. The opportunity for solitude and primitive, unconfined recreation would be maintained and no new permanent developments or human occupancy would be authorized. Natural ecological processes and disturbances would continue to be the primary forces affecting the composition, structure and patterns of vegetation.

The Ansel Adams and John Muir Wildernesses would continue to be managed for low density, low disturbance, and widely distributed visitor use. In popular destination areas, impacts associated with visitor use would continue to be concentrated by limiting visitor freedom to established overnight camping sites and areas. Group size limits, wilderness permits, and other restrictions on overnight occupancy would continue to be implemented to effectively manage visitor use levels and maintain or improve opportunities for solitude. Biophysical impacts associated with recreation would be reduced by prohibiting camping in areas that have experienced high levels of impact and are in need of restoration.

Alternative A has forestwide noxious weed direction, but the direction does not include all invasive species like the plan revision alternatives, and direction for aquatic invasive species is not adequate. Alternative A lacks specific guidelines and components which would provide for restoration in wilderness, address all invasive species, and support social and natural qualities of wilderness character. If these aspects of wilderness character are not maintained, there would likely be long-term adverse impacts on natural quality of wilderness character.

Consequences to Designated Wilderness from Other Relevant Resource Programs

Alternative A does not provide management direction that would increase restoration activities on adjacent lands to existing wilderness. Catastrophic fires and tree mortality on adjacent lands could put existing wilderness areas at risk, and could cause a long-term decline in the quality of wilderness character in those wilderness areas.

Natural, unplanned ignitions would continue the long-term ecological processes in existing wilderness areas. There could be a short-term loss of vegetation, reduction in water quality due to sedimentation, and effects from smoke; however, these effects are part of the natural ecological processes and would help maintain natural qualities of wilderness character.

Table 86 shows the three different fire management zones in existing designated wilderness areas under alternative A. Both the Wildland-urban Intermix Defense and Threat Zones emphasize hazardous fuels reduction treatments and lack management direction to restore fire as an ecological process, which would be likely to have adverse effects on existing wilderness characteristics. Some wildfires may be managed to meet resource objectives when conditions allow and it can be done in a safe manner which could have beneficial effects on wilderness characteristics.

Table 86. Percentage of area in fire management zones for areas in designated wilderness, alternative A

Wildland-urban Intermix Defense Zone	Wildland-urban Intermix Threat Zone	Other
less than 1 percent	7 percent	93 percent

Consequences Specific to Alternatives B-modified, B, C, and D

Like alternative A, management would continue to be guided by wilderness management plans in those wilderness areas that have plans (Ansel Adams, Golden Trout, Hoover, and John Muir wilderness areas), which provide more specific management guidance.

The Ansel Adams and John Muir Wildernesses would continue to be managed for low density, low disturbance, and widely distributed visitor use. In popular destination areas, impacts associated with visitor use would continue to be concentrated by limiting visitor freedom to established overnight camping sites and areas. Group size limits, wilderness permits, and other restrictions on overnight occupancy would continue to be implemented to effectively manage visitor use levels and maintain or improve opportunities for solitude. Biophysical impacts associated with recreation would be reduced by prohibiting camping in areas that have experienced high levels of impact and are in need of restoration.

Under all plan revision alternatives, plan direction would guide management of existing wilderness areas using desired conditions and guidelines described in the wilderness section of chapter 3 of the revised plan. Management direction under all plan revision alternatives would continue to protect and maintain the five qualities of wilderness character in designated wilderness. Opportunities for solitude and primitive, unconfined recreation would be maintained and no new permanent developments or human occupancy would be authorized. Natural ecological processes and disturbances would continue to be the primary forces affecting the composition, structure and patterns of vegetation.

Direction under all plan revision alternatives for existing designated wilderness areas would continue to ensure that there is a balance between maintaining recreation opportunities for pack stock use in wilderness and sustaining ecological resources in wilderness.

There are guidelines and components under alternatives B-modified, B, C, and D that are not addressed under existing forest plan direction. This revised direction would be beneficial to aspects of wilderness character not addressed in existing wilderness plan direction, including providing for restoration in wilderness, addressing invasive species, and supporting social and natural qualities of wilderness character.

In addition to plan components that apply to all designated wilderness areas, the Ansel Adams and John Muir Wildernesses have additional desired conditions defined within three wilderness recreation categories. Similarly, the South Sierra Wilderness has desired conditions defined by four opportunity classes. This direction specific to these three wilderness areas would be beneficial to the protection of wilderness character because it would provide a site specific approach.

Consequences to Designated Wilderness from other Relevant Resource Programs

Consequences Specific to Alternatives B, B-modified, and D

Alternatives B, B-modified, and D would provide management direction that would likely increase restoration activities on adjacent lands to existing wilderness compared to alternative A, which would be beneficial to protecting existing wilderness areas.

Like alternative A, natural, unplanned ignitions would continue the long-term ecological processes in existing wilderness areas under alternatives B, B-modified, and D. There could be a short-term loss of vegetation, reduction in water quality due to sedimentation, and negative impacts from smoke; however, these effects are part of the natural ecological processes and would help maintain the long-term natural qualities of wilderness character.

In alternatives B, B-modified, and D there are four fire management zones shown in table 87. The Community Wildfire Protection Zone and General Wildfire Protection Zone emphasize fuel treatments that would not enhance ecological processes and natural characteristics; however, these would be necessary management tradeoffs to protect communities. The wildfire restoration zone prioritizes ecological restoration, which could have short-term adverse effects on wilderness characteristics, but long-term benefits to wilderness character would outweigh any short-term negative impacts. In areas in the wildfire maintenance zone, fire management activities would be likely to retain and have beneficial effects to wilderness characteristics because this zone emphasizes management of wildfires to meet resource objectives, and to a slightly greater extent under alternative B. This would allow ecological benefits to the natural quality of wilderness character to occur under alternatives B, B-modified and D.

Table 87. Percentage of area in fire management zones for areas in designated wilderness, alternatives B, B-modified, and D

Alternative	Community Wildfire Protection Zone	General Wildfire Protection Zone	Wildfire Restoration Zone	Wildfire Maintenance Zone
B	3	14	27	56
B-modified and D	2	12	32	53

Consequences Specific to Alternative C

In alternative C, there are three fire management zones for existing designated wilderness shown in table 88: the Wildland-urban intermix Defense Zone which is the same as in alternative A; the Wildfire Maintenance Zone is the same as in alternatives B and D; and the General Wildfire Zone for the remaining area. The General Wildfire Zone would have an increased emphasis on managing wildfire to meet resource objectives and increased use of prescribed fire in fire adapted ecosystems and could potentially put wilderness resources at risk. Of the three fire management zones in alternative C, the Wildfire Maintenance Zone would be the most likely to have benefits to wilderness characteristics, where wildfires could be safely managed while still restoring fire as an ecosystem process. The general wildfire zone may make it more difficult to evaluate wildfire risk resulting in slightly less wildfires managed to meet resource objectives within existing wilderness areas. The fewer fuels reduction treatments that would occur adjacent to wilderness areas would result in higher risks to managing wildfires inside wilderness, which could negatively impact many aspects of wilderness character inside wilderness.

Table 88. Percentage of area in fire management zones for areas in designated wilderness, alternative C

Wildland-urban Intermix Defense Zone	General Wildfire Zone	Wildfire Maintenance Zone
less than 1	46	54

Consequences Specific to Alternative D

Management direction provided under alternative D would likely have the most beneficial effect to protection of existing designated wilderness due to the increased pace and scale of restoration activities that would occur on lands adjacent to existing wilderness areas.

Cumulative Effects

Past, present and reasonably and foreseeable actions that have the potential to cumulatively affect existing wilderness areas include activities such as vegetation management, mining, recreation use, and fuels reduction activities that would occur adjacent to existing wilderness areas. These actions could impact the wilderness characteristics of solitude inside existing wilderness areas, depending on how close and persistent the actions are. For example, mining activities adjacent to an existing wilderness may increase the sights and sounds of motorized equipment heard within a wilderness. Expansion of a developed recreation site adjacent to an existing wilderness area could increase use levels within the wilderness, which could have impacts on solitude as the number of encounters with others could increase within that wilderness. Past, present, and reasonably and foreseeable actions when considered with management direction of plan revision alternatives would not be expected to have long-term cumulative impacts on the wilderness characteristics of solitude because there are plan components and wilderness plan direction that protect solitude.

Population growth in California and Nevada would be likely to increase wilderness visitation that could result in cumulative impacts to wilderness character, including opportunities for solitude and natural quality. Examples of potential impacts would include decreased opportunities for solitude in high use areas, soil compaction or erosion, and threats to native plant species from the spread of noxious weeds from sources outside the wilderness. Management direction for wilderness in plan revision alternatives would help protect wilderness characteristics of solitude and natural qualities from long-term cumulative impacts of population growth.

Analytical Conclusions

Many aspects of wilderness management direction across all alternatives is similar since much of the direction is derived from law, regulation, and agency policy. This would result in similar effects to wilderness character across all alternatives; however, alternatives differ in the following ways:

Alternative A lacks sufficient guidelines and components which would provide for adequate restoration in wilderness, address invasive species, and support social and natural qualities of wilderness character. If these aspects of wilderness character are not maintained, there would likely be long-term adverse impacts on natural quality of wilderness character. Alternative A also does not provide management direction that would increase restoration activities on adjacent lands to existing wilderness which could cause a long-term decline in the natural quality of wilderness character inside wilderness.

There are new guidelines and components under alternatives B-modified, B, C, and D which are not addressed under existing forest plan direction. This revised direction would be beneficial to aspects of wilderness character not addressed under alternative A, including providing for restoration in wilderness, addressing invasive species, and supporting social and natural qualities of wilderness character.

Since Alternatives B, B-modified and D have similar fire management direction inside wilderness; beneficial impacts to maintain and enhance wilderness character would be similar across these three alternatives. A large portion of the existing designated wilderness areas are within the wildfire maintenance zone, where fire risk is lower and generally favors managing wildfires to meet resource objectives. Plan direction for alternatives B, B-modified, C, and D would encourage restoring fire as an ecological process when it is safe to do so in the wildfire maintenance zone. Alternative C, although it would result in some benefits to wilderness character under the Wildfire Maintenance Zone, it would be the least beneficial to managing wildfire while protecting and enhancing wilderness characteristics out of all the plan revision alternatives.

Management direction provided under alternative D for fire, fuels, and restoration on lands adjacent to wilderness areas would likely have the most beneficial effect to protection of bordering wilderness areas. This is due to the increased pace and scale of restoration activities that would occur on lands adjacent to existing wilderness areas.

Recommended Wilderness

The Forest Supervisor for the Inyo National Forest is required by the 2012 Planning Rule[40] to "identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System, and determine whether to recommend any such lands for wilderness designation." Any lands the Forest Supervisor recommends for wilderness designation through forest plan revision would be a preliminary administrative recommendation, and are referred to as "recommended wilderness" below.

[40] 36 CFR 219.7 (v)

Analysis and Methods

The analysis area for effects includes recommended wilderness in alternatives B, B-modified, and C and effects under alternatives A and D in the absence of wilderness recommendations. The timeframe for the environmental consequences is dependent upon whether the preliminary administrative recommendations are addressed by the U.S. Congress. The timeframe for the environmental consequences related to any recommended wilderness would be the expected life of the forest plans, or 10 to 15 years, unless the recommended wilderness is designated by Congress, in which case the timeframe for environmental consequences would be the long term, or more than 20 years.

Indicators and Measures

These indicators were developed in response to comments and to show how management is affected by recommended wilderness:

- Protection of wilderness character
- Ability to manage recommended wilderness areas
- Ability to conduct vegetation, fire, watershed and wildlife habitat management
- Change in miles of system trails that allow mechanized transport within areas recommended for wilderness

Methods

This analysis includes a qualitative discussion of the effects of the proposed management direction of recommended wilderness areas, or lack thereof, in the different alternatives. Wilderness character, the Inyo's ability to manage recommended wilderness, the Inyo's ability to conduct fuels, fire and wildlife habitat management, and any change in the miles of system trails that allow mechanized transport within areas recommended for wilderness are all used to measure the effects of each alternative.

Affected Environment

The process to identify and evaluate lands on the Inyo National Forest that may be suitable for inclusion in the National Wilderness Preservation System is documented in appendix B: Wilderness Evaluation for the Inyo National Forest (volume 2). Appendix B also documents the process used for identifying which evaluated areas to analyze in one or more alternatives in the draft environmental impact statement. Detailed information and maps for each area included as recommended wilderness in the analysis, and the rationale for areas or portions of areas that are not included in the analysis, can also be found in appendix B.

Alternatives A and D do not include any new recommended wilderness. Alternatives B and B-modified include four new recommended wilderness areas totaling 37,029 acres on the Inyo National Forest. Alternative C includes 24 new recommended wilderness areas totaling 315,531 acres.

Existing designated wilderness comprises almost 46 percent of the Inyo National Forest, for a total of 964,360 wilderness acres. There are nine existing designated wilderness areas, either in whole or part, within the administrative boundary of the national forest. Existing designated wilderness areas are described in the previous section ("Designated Wilderness").

Overview of Recommended Wilderness Proposed in Alternatives B, B-modified, and C

Alternatives B and B-modified

In alternatives B and B-modified, four areas totaling 37,029 acres are recommended as wilderness additions, all of which adjoin existing designated wilderness as shown in table 89.

Table 89. Recommended wilderness additions adjacent to existing designated wilderness in alternatives B and B-modified

Recommended Wilderness Addition	Size (acres)
Piper Mountain Wilderness Addition	11,840
South Sierra Wilderness Addition	17,622
White Mountains Wilderness Addition – East	2,505
White Mountains Wilderness Addition – West	5,062

Special Uses and Other Uses in Recommended Wilderness under Alternatives B and B-modified

Wilderness recommendations under alternatives B and B-modified include one known water right in the Piper Mountain Addition. Additionally, there may be a special use facility for a creek bypass pipeline intake in alternatives B and B-modified in the South Sierra Wilderness Addition East (1). There is also a private inholding within the White Mountains Wilderness Additions (West).

There are two existing grazing allotments within recommended wilderness polygons in alternatives B and B-modified: one within the White Mountains Additions (East) and one within the South Sierra Wilderness Addition – East (1).

Alternative C

In alternative C there are 24 areas totaling 325,352 acres of new recommended wilderness, of which 9 areas (73,473acres) are adjacent to existing designated wilderness and 15 areas (251,879acres) are not. Approximately 23 percent of the new recommended wilderness areas in alternative C is adjacent to existing designated wilderness as shown in table 90.

Table 90. Recommended wilderness additions adjacent to existing designated wilderness in alternative C

Recommended Wilderness Addition	Size (acres)
Ansel Adams Wilderness Addition – Northeast	7,046
Golden Trout Wilderness Addition – East	6,008
Inyo Mountain Wilderness Addition	7,479
Piper Mountain Wilderness Additions (1)	11,313
Piper Mountain Wilderness Additions (2)	2,726
South Sierra Wilderness Additions – East (1)	25,469
South Sierra Wilderness Additions – East (2)	1,514
White Mountains Wilderness Additions – East	3,288
White Mountains Wilderness Additions – West	8,630

Approximately 77 percent of new recommended wilderness areas on the Inyo National Forest are not adjacent to existing designated wilderness as shown in table 91.

Table 91. Recommended wilderness not adjacent to existing designated wilderness in alternative C

Recommended Wilderness	Size (acres)
Adobe Hills	10,354
Deadman Canyon	15,910
Deep Springs North	34,716
Dexter Canyon	8,740
Glass Mountains	35,749
Huntoon Creek	8,876
Marble Canyon	15,867
Marble Creek	13,707
Mazourka Peak	42,927
McBride Flat	10,621
Pizona-Truman Meadows	19,957
Redding Canyon	8,906
Silver Creek	8,630
Soldier Canyon	11,024
South Huntoon Creek	5,895

Special Uses and Other Uses in Recommended Wilderness under Alternative C

Wilderness recommendations under alternatives C include one known water right in the Piper Mountain Addition and seven additional known water rights within the Ansel Adams, Deadman Canyon, and Marble Creek Additions. Additionally, there may be up to 28 water-related special use facilities that are within wilderness additions under alternative C. Some of these facilities may only be in a proposed status and may not actually exist. There are also two private inholdings in alternative C: one within the White Mountains Wilderness Additions (West) and one within the Glass Mountain Addition.

There are a total of six grazing allotments within recommended wilderness polygons in alternative C. Three of these allotments have no known associated improvements associated with the allotments, only grazing activities (these are within the White Mountains Additions (East), the South Sierra Wilderness Addition – East (1), the Deadman Canyon Addition). There are three grazing allotments with associated improvements such as fences and water troughs (these are within the Dexter Canyon Addition, Golden Trout Addition, and South Sierra Addition – East (2).

There are several existing outfitter and guide special use permits under three of the proposed wilderness additions in alternative C in the Ansel Adams, Glass Mountain, and Marble Creek Additions. These outfitter and guides operate under special use permit for activities such as hunting and backpacking.

Under alternative C there is one known active mining claim within the Pizuna-Truman Meadows addition and an old mining site in the Marble Creek Addition where some mining activity may still occur.

There are wild horse management areas within five of the recommended additions in alternative C within Adobe Hills, Huntoon Creek, McBride Flat, Pizona-Truman Meadows, and the South Huntoon Creek Additions. There are no known existing structures associated with the wild horse management areas.

Environmental Consequences of Recommended Wilderness

Consequences Common to Alternatives B, B-modified, and C

Making the preliminary wilderness recommendation for a forest plan revision does not create or designate a wilderness. Congress must pass legislation designating wilderness. The plan direction for recommended wilderness would protect the values that make the area suitable for wilderness designation.

Recommending wilderness areas adjacent to existing designated wilderness would have the beneficial effect of enhancing wilderness character because existing wilderness areas would be buffered by the four recommended wilderness areas under alternatives B and B-modified, and nine under alternative C. The recommended additional acreage adjacent to these existing wilderness areas would serve to buffer the existing wildernesses from sights and sounds of humans (motor vehicle sounds, chainsaws, etc.), thereby benefiting wilderness characteristics of solitude on the edges of the existing wilderness areas. This would be the most beneficial under alternative C since there are nine adjacent recommended additions; however, conversely, alternative C also has an increased potential for large wildfires due to the challenges of conducting restoration activities in wilderness (see “Terrestrial Vegetation Ecology” section), and this could also put existing wilderness resources at risk, to the greatest extent in alternative C.

Recommending wilderness areas adjacent to existing designated wilderness could have beneficial effects to wildlife by providing additional contiguous habitat for at-risk species, thereby improving the natural characteristics of existing wilderness areas. Alternative C would add the most acres of contiguous habitat, followed by alternatives B and B-modified. Benefits to contiguous wildlife habitat would be the most beneficial under alternative C since there are nine adjacent recommended additions. However, recommended wilderness direction also has potential to negatively impact contiguous wildlife habitat by limiting the types of restoration activities that could occur (see “Terrestrial Vegetation Ecology” section) in newly recommended wilderness areas, to the greatest the greatest extent under alternative C.

Recommended wilderness areas under plan revision alternatives could serve to also benefit wildlife and at-risk species by precluding management activities (like timber harvest) that might reduce habitat quality, and by limiting mechanized and motorized activities such as mountain biking and off-highway-vehicle use that could cause breeding disturbance. This conservation approach has long been employed as a means to help protect natural resources from degradation associated with human actions. Wilderness management areas are also locations where wildfires are often managed to meet resource objectives, such as restoring fire as a key ecosystem process in Sierra systems, which can substantially improve wildlife habitat condition, heterogeneity, structural diversity, and species composition of vegetation (MA-WILD-DC-01; MA-WMZ-STD-01 to 02). However, recommended wilderness direction has the potential to also negatively impact wildlife (both terrestrial and aquatic species) by limiting restoration activities and by continuing or increasing disturbance from wilderness users, to the greatest extent under alternative C (see “Wildlife, Fish and Plant” and “Fire Trends” section).

Climate change has been associated with and will continue to influence shifts in ecological processes and patterns, and species ranges, movements, and phenologies among other newly emerging patterns (Cole and Yung 2012, Bradley et al. 1999, Safford et al. 2012)). While wilderness recommendations could serve to benefit terrestrial and aquatic wildlife species, and offer protection from impacts of climate change, protection of species and community assemblages may be limited to a snapshot in time and may not be protective in the future if natural processes aren't sufficient to maintain habitat conditions due to factors such as climate change, large high-intensity fire, nonnative species invasions (like invasive plants and barred owl), insect outbreaks, and pathogens, among others (See Wildlife, Fish and Plants section). Alternative C presents the greatest challenge to maintaining wildlife habitat conditions to desired conditions since restoration activities in recommended wilderness would be more much more difficult under this alternative. Alternatives B and B-modified would provide a balance of ecological benefits from adding four additional wilderness areas, while still allowing for restoration activities to occur across much of the rest of Inyo National Forest.

None of the recommended wilderness areas in alternatives B, B-modified, or C intersect an existing National Forest System road or motorized trail. The process used to identify possible suitable wilderness areas took into account whether an area had existing system roads, and buffered those roads and removed the buffered area from the polygons (cherry stem roads; see volume 2, appendix B). Therefore, the impact of moving motorized users outside of the recommended wilderness areas to other areas of the national forest would be minimal; however, there may be an effect on access by mountain bikes in alternative C, which could potentially displace mountain bikers to other areas. However, given the topography and sandy soil type of these trails, the likelihood that this would be an adverse impact is low since very little mountain bike use is known to occur on the affected trails. Changing to recreation opportunity settings under all plan revision alternatives are displayed in table 78 in the "Sustainable Recreation and Scenery" section. There are no other known changes in recreation activities associated with the recommended wilderness areas, therefore it is not anticipated that the recommended wilderness areas would have impacts to increasing recreation use in non-wilderness areas.

Recreation Settings and Opportunities, Access, and Recreation Management

Consequences Specific to Alternative A

No additional wilderness acreage is recommended under alternative A; however, not recommending additional wilderness now, may limit the amount of area that would be recommended for designation by Congress in the future. Once inventoried and analyzed for potential wilderness recommendation, areas not selected for such recommendation may be managed for other purposes in the future which could diminish their wilderness character.

Since there are no recommended wilderness areas under alternative A, there would be no reduction in acres of motorized recreation opportunity spectrum settings, which would be beneficial to motorized recreation settings because motorized opportunities would remain status quo. There would also be no change to mechanized access (mountain bikes), so mechanized trail access eliminated under alternative C would remain under alternative A. This would additionally be beneficial to the potential of future mechanized and motorized access, as trails could be added in the future in the absence of the recommended additions.

With limited staffing, declining budgets, and almost a million acres of existing wilderness to manage, an absence of recommended wilderness areas would have a small benefit of enabling recreation management to focus law enforcement and education efforts on existing wilderness areas. This would also allow existing trails to be maintained using mechanized equipment, which is a much more efficient means to maintain trails. However, in the absence of any recommended wilderness, there would no long-term social or ecological benefits derived from new wilderness designation.

Consequences Specific to Alternatives B and B-modified

Alternatives B and B-modified identify four areas on the Inyo National Forest as administrative recommendations for inclusion in the National Wilderness Preservation System (South Sierra Wilderness – East Addition; the White Mountains Wilderness Additions; and the Piper Mountain Wilderness Addition). The four areas are adjacent to existing designated wilderness area boundaries. These areas would be managed to retain their social and ecological wilderness characteristics and other identified features of value until their designation as wilderness or other use by Congress (MA-4WLD-DC, MA-RWLD-STD, MA-RWLD-SUIT, MA-RWLD-GOAL). General desired conditions, guidelines, and suitability defined in the Revised Forest Plan would also apply to the recommended wilderness areas until and unless such time as Congress designates the areas for other use (DA-WILD-DC, DA-WILD-GDL, and DA-WILD-GDL).

The recreation opportunity spectrum map reflects the recreation opportunities settings associated with the recommended wilderness areas (see maps in volume 4). Recommended additions under alternatives B and B-modified would result in expanded wilderness recreation opportunities for nonmotorized users seeking backcountry day-use and overnight opportunities. There would be a slight decrease in motorized recreation opportunities from the current plan (alternative A) due to the change in recreation opportunity spectrum settings; however, this impact is considered negligible since it would not result in any closures of motorized routes. There would be no change to mechanized recreation opportunities (mountain bike) because none of the four recommended wilderness areas would close off any trails to mountain bikes. Recommended wilderness areas would cease to allow mining operations, timber production, or motorized use except as specifically provided for in the Wilderness Act.

There are no known climbing areas with fixed anchors in any of the recommended wilderness areas in the preferred alternative. Climbing as a recreation activity is discussed in the Wilderness Evaluations (volume 2, appendix B). The use of power drills would be prohibited by law in recommended wilderness, however the rock climbing activities would still be allowed as a form of primitive recreation under the Wilderness Act 1964. Therefore, wilderness recommendations in the draft plan would not affect existing climbing opportunities, it would only prohibit the potential for developing future climbing routes that use fixed anchors.

Hunting opportunities in recommended wilderness areas under alternatives B and B-modified would have minimal impacts since these opportunities would still be allowed in wilderness. There is one known wildlife guzzler in recommended wilderness under this alternative, yet it would still be considered feasible for the Inyo to continue to maintain this guzzler if mechanized and motorized access was not approved under a minimum requirements decision. See the discussion under the “Special Uses and Other Uses” section for a more detailed description of impacts to guzzlers.

Consequences Specific to Alternative C

Alternative C includes 24 recommended wilderness areas for a total of 315,531 acres to be considered for inclusion in the National Wilderness Preservation System. These recommended wilderness areas would be managed in the same manner as designated wilderness to maintain their wilderness characteristics, including their natural conditions, opportunities for solitude or primitive and unconfined recreation, scenic beauty, and identified special features.

The Ansel Adams Addition under alternative C is in close proximity to concentrated recreation use and facilities, and highways in the south and north portions of the area. The proximity to concentrated recreation use and highways would reduce opportunities for solitude in the recommended wilderness and could cause negative impacts to that nonmotorized recreation setting.

The Wilderness Act specifies wilderness "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness." Since the Inyo National Forest currently has just two backcountry rangers to cover approximately 1 million acres of existing wilderness, adding such a substantial amount of acreage under alternative C would limit opportunities for visitor contacts to inform, educate, and regulate activities, as appropriate in both new and existing wilderness areas. Additionally, with substantial acreage already allocated to wilderness, trail maintenance and development is challenging. It is especially difficult for forest staff to rebuild trails after major damage occurs because of the lack of roaded access, and the inability to use motorized or mechanized equipment. This would likely cause negative impacts to nonmotorized trail access.

The Inyo National Forest already has a documented problem with motorized incursion into existing wilderness as documented through law enforcement contacts. Inyo staff recorded 51 incidents of wilderness trespass with a motorized vehicle, and one with a bicycle, from 2010 through 2016. These incidents were recorded as "ongoing" meaning there was evidence of more than one occurrence of trespass at a particular site, such as tire tracks, or vandalized blocking installations. Much of this trespass occurs in areas that are within 100 feet of highways, or adjacent to towns and ski areas. In many cases, the wilderness trespass was unintentional – the entirety of wilderness boundaries can't be marked, and users are often unaware of the location, existence, or rules of wilderness. Adding additional acreage of wilderness to monitor for incursions would increase demands for law enforcement patrols and possibly reduce law enforcement presence in existing wilderness which could have negative impacts on maintaining and enhancing wilderness character in existing wilderness.

Alternative C would be the most beneficial to nonmotorized recreation opportunity settings by providing increased opportunities for solitude. Although the recommended wilderness areas under alternative C would not impact any existing motorized roads or trails, motorized restrictions that would likely be imposed in the recommended wilderness areas would limit any future development of off-highway vehicle recreation opportunities, to the greatest extent in alternative C.

Alternative C would have the greatest impact on mechanized access (mountain bikes) out of all the alternatives because of the additional recommended wilderness areas. There are six recommended wilderness areas in this alternative that contain 43 miles of system trails which currently allow mountain bike use. A plan component (MA-WILD-SUIT-04) makes mechanized transport unsuitable in recommended wilderness areas; therefore, trail access by mountain bikes would be decreased by 43 miles on system trails, which is a 9 percent reduction in nonmotorized trails open to mountain bikes compared to A, B, B-modified, and D. Given the topography and sandy soils of where these trails are located, only a minor impact to existing mechanized access would be expected under this alternative; however, the restrictions associated with wilderness designation would also limit any future development of mountain bike access.

There are no known climbing areas with fixed anchors in any of the recommended wilderness areas in alternative C. Climbing as a recreation activity is discussed in the Wilderness Evaluations (FEIS, Vol. 2, appendix B). The use of power drills would be prohibited by law in recommended wilderness, however the rock climbing activities would still be allowed as a form of primitive recreation under the Wilderness Act 1964. Therefore, wilderness recommendations in alternative C would not affect existing climbing opportunities; however, alternative C would have the greatest impact on prohibiting the potential for developing future climbing routes that use fixed anchors.

There could be negative impacts to hunting opportunities in recommended wilderness areas under alternative C if conditions of guzzlers deteriorated without mechanized and motorized access to guzzlers approved under a minimum requirements decision. See the discussion under the Special Uses and Other Uses Section for a more detailed description of impacts to guzzlers. There could be negative impacts on hunting opportunities if conditions of guzzlers deteriorated because wildlife would likely relocate to other areas to find water.

Consequences Specific to Alternative D

No areas are recommended for inclusion in the National Wilderness Preservation System in alternative D because the restrictions imposed on wilderness prohibit the use of motorized and mechanized equipment and would limit the increased pace and scale of mechanical restoration treatments, prescribed burning, and managing wildfires to meet resource objectives proposed in this alternative.

Environmental consequences under alternative D on recreation settings and opportunities, access, and recreation management would be similar to alternative A except for the following: The trade-off in this alternative, like alterative A would be a lack of long term social and ecological benefits in the absence of recommending new wilderness areas, and like alternative A, these lands could be susceptible to uses that would not be compatible with nonmotorized uses if kept in the existing management status.

Vegetation, Fire, Wildlife Habitat, and Watershed Management

The fire management zones that are analyzed for each alternative are described in detail in the “Fire Management and Smoke” section.

Consequences Specific to Alternative A

Because there would be no new wilderness recommendations under alternative A, this would allow the full suite of management tools to be available for vegetation and fuels management activities. Landscape-level fuels and forest restoration treatments would be more likely to occur in those areas not recommended as wilderness in the absence of the wilderness recommendations; however, there would be no ecological or social benefits derived from recommending new wilderness areas.

Consequences Specific to Alternatives B and B-modified

Wilderness designation does not preclude vegetation and fuels management, but it does make many of the usual management tools unavailable. Large-scale fuels treatments and forest habitat restoration activities would be more limited in areas recommended for wilderness due to the management challenges of working in wilderness. However, under alternatives B and B-modified, the ecological and social benefits to adding these adjacent wilderness areas would likely outweigh the management challenges of conducting fuels and vegetation management activities inside wilderness.

When wildfires start, or burn into wilderness, the tools available to manage those fires are more limited than outside wilderness; however, fire managers are still able to work with these limitations. Employing fire and fuels management activities where necessary would benefit the natural character of wilderness and ensure ecosystem protection inside recommended wilderness areas. Wilderness just requires a different approach from wildfire response in areas recommended or designated as wilderness. Prescribed fire could still be used in recommended wilderness areas, when the benefits to overall wilderness character would be improved and documented in a minimum requirements analysis decision.

The fire management zones that are analyzed for each alternative are described in detail in the "Fire Management and Smoke" section. In alternatives B and B-modified there are four fire management zones that would affect the four recommended wilderness areas (table 92). The community wildfire protection zone and general wildfire protection zone emphasize fuel treatments that would likely have an adverse effect on wilderness characteristics; however, these would be necessary management tradeoffs to protect communities and resources. The wildfire restoration zone prioritizes ecological restoration, which could have short-term adverse effects on solitude and untrammeled wilderness characteristics, but the long-term benefits to the natural quality of wilderness character would outweigh any short-term negative impacts on solitude and untrammeled qualities. In areas in the wildfire maintenance zone, fire management activities would be likely to retain and have beneficial effects to existing wilderness characteristics because this zone emphasizes management of wildfires to meet resource objectives. This would allow long-term ecological benefits to the natural quality of wilderness character to occur under these alternatives, with alternative B slightly higher since it has higher percent in the wildfire maintenance zone.

Table 92. Percentage of area in fire management zones for areas in recommended wilderness, alternatives B and B-modified

Alternative	Wildfire Protection Zone	General Wildfire Protection Zone	Wildfire Restoration Zone	Wildfire Maintenance Zone
B	1	17	6	76
B-modified	2	43	4	51

Wildlife habitat connectivity would be enhanced between the existing and proposed wilderness areas. Such connectivity is important to maintaining wildlife corridors and bird migration routes. The connectedness of open space, species habitat, and ecological processes are important to biodiversity and ecological integrity (Lindenmayer and Fischer 2013). The increased connectivity would likely benefit species richness.

Recommended wilderness polygons in alternatives B and B-modified would also help enhance the natural quality of wilderness by ensuring the functions of ecosystems are maintained in recommended areas. These ecosystems contain valuable hydrologic resources which would have a higher level of protection from unnatural disturbances, and allowed to have natural processes maintained which would protect and enhance hydrologic resources. Acres of wildfires managed to meet resource objectives is expected to go up in all alternatives B and B-modified B. This will help reduce the risk of a large stand-replacing wildfire that can negatively affect hydrologic resources.

There is a small amount of sage-grouse habitat (a species of conversation concern) within the White Mountain West addition in alternatives B and B-modified. This wilderness addition would benefit the natural quality of wilderness character by protecting sage-grouse habitat from uses that conflict with its habitat protection. Although the Inyo's ability to manage this habitat would be limited to nonmechanized methods and vegetation management methods compatible with wilderness policy, the benefits of protecting this area as wilderness outweigh the challenges of managing habitat for sage-grouse, particularly given the small amount of habitat inside the recommended addition. The impacts of managing sage-grouse habitat on wilderness character would be minimal given the small amount of habitat inside the addition.

Since only alternative B-modified includes development of conservation watersheds, there would be beneficial effects to Cottonwood-Crooked Creek Headwaters conservation watershed in the proposed White Mountain East and West additions because future development would be prohibited, which would maintain the watershed condition rating of relevant indicators.

Consequences Specific to Alternative C

As mentioned under alternatives B and B-modified, wilderness designation does not preclude vegetation and fuels management, but it does make many of the usual management tools unavailable. Large-scale fuels treatments and forest habitat restoration would become increasingly difficult under alternative C given the large amount of acreage recommended for wilderness designation. Additionally, when wildfires start, or would burn into recommended wilderness, the normal tools available to manage those fires are limited. This could impede future fire management efforts to the detriment of resources both inside and outside recommended wilderness areas. Fire managers are able to work with these limitations, but they require a much different approach from wildfire response in areas not recommended or designated as wilderness.

A major wildlife habitat management issue on the Inyo National Forest is pinyon pine encroachment on sage-grouse habitat. Although recommended wilderness would provide some ecological benefits to sage-grouse habitat, it would also limit the Inyo's ability to manage the habitat for conifer encroachment. Mechanical thinning of sage-grouse habitat would not be possible under this alternative and the challenges of managing the habitat for sage-grouse would likely outweigh the potential ecological benefits gained in this alternative due to the large amount of recommended wilderness acres recommended. In addition, impacts from restoration activities that would be required to adequately maintain sage-grouse habitat would impact the untrammeled quality of wilderness character because conifer removal and prescribed fire activities would be evident. Prescribed fire impacts would persist for only short-term periods of time while hand thinning activities would be a long term impact on wilderness character because cut stumps would be visible for longer periods unless otherwise removed and burned.

Recommending wilderness areas adjacent to existing designated wilderness could have beneficial effects to wildlife by providing additional contiguous habitat for at-risk species, thereby improving the natural characteristics of existing wilderness areas. Benefits to contiguous wildlife habitat would be the greatest under alternative C since there are nine adjacent recommended additions. However, recommended wilderness direction also has potential to negatively impact contiguous wildlife habitat by limiting the types of restoration activities that could occur (see Terrestrial Vegetation Ecology section), thereby leaving these areas more prone to the risk of large catastrophic wildfires.

In alternative C, there are three fire management zones as shown under table 93: The Wildland-urban Intermix Defense Zone, which is the same as in alternative A; the Wildfire Maintenance Zone is the same as in alternatives B and D; and the General Wildfire Zone for the remaining area. The General Wildfire Zone would have an increased emphasis on managing wildfire to meet resource objectives and increased use of prescribed fire in fire adapted ecosystems. Of the three fire management zones in alternative C, the Wildfire Maintenance Zone would be most likely to retain wilderness characteristics where wildfires can be safely managed to restore fire as an ecosystem process. The General Wildfire Zone may make it more difficult to evaluate wildfire risk resulting in slightly less wildfires managed to meet resource objectives within recommended wilderness areas. Fewer fuels reduction treatments outside of but adjacent to wilderness area would result in higher risks to managing wildfires.

Table 93. Percentage of area in fire management zones for areas in recommended wilderness, alternative C

Wildland-urban Intermix Defense Zone	General Wildfire Zone	Wildfire Maintenance Zone
less than 1	59	41

Alternative C would increase the range of elevations and increase the biodiversity of areas recommended for inclusion in the National Wilderness Preservation System, which would likely benefit wildlife species affected by impacts from climate change. The recommended additions to the Ansel Adams Wilderness contain the aspen ecosystem type, which supports very diverse understory plant and bird communities. There would be benefits to both ecological resources and the natural qualities of wilderness as a result of the wilderness additions under alternative C, but with a limited means to conduct restoration activities in proposed wilderness areas, these new wilderness resources could be threatened by catastrophic wildfires and tree mortality.

Recommended wilderness polygons in alternative C (like alternatives B and B-modified) would also enhance the natural quality of wilderness by ensuring the functions of ecosystems are maintained in recommended areas. These ecosystems contain valuable hydrologic resources which would have a higher level of protection from unnatural disturbances, and allowed to have natural processes maintained which would protect and enhance hydrologic resources. Acres of wildfires managed to meet resource objectives is expected to go up in all alternatives, which would help reduce the risk of a large stand-replacing wildfire that can negatively affect hydrologic resources. However, there would also be management challenges to implementing restoration activities with the large number of recommended wilderness areas in alternative C, due to the limited tools available to conduct restoration. This could put ultimately put wilderness resources at risk.

Consequences Specific to Alternative D

In the absence of wilderness recommendations in alternative D, an increased pace and scale of mechanical restoration treatments, prescribed burning, and managing wildfires would help meet resource objectives proposed in this alternative. A full suite of management tools would be available to conduct fuels, fire management, and restoration activities; however, there would be no ecological or social benefits derived from recommending wilderness areas.

Management direction under alternative D provides for increased restoration activities, which would have beneficial impacts to protecting existing adjacent wilderness areas. Although this positive impact is also highlighted under the existing wilderness section, it is noted in the recommended wilderness section because in the absence of any wilderness area recommendations; alternative D would offer the highest level of protection of adjacent borders of existing wilderness resources because of the increased pace and scale of restoration activities. Those areas not recommended as wilderness would be the more likely to undergo fuels or vegetation treatments under this alterative, thereby serving as a buffer to prevent catastrophic wildfires and tree mortality in bordering wilderness areas. This could have short-term impacts on wilderness solitude in border areas of adjacent wilderness, but the long-term benefits would outweigh the short-term impacts. Beneficial impacts are considered minor since they are only in the context of border zones of adjacent wilderness areas.

Special Uses and Other Uses

Consequences Common to Alternatives B, B-modified, and C

Wilderness recommendations under alternatives B, B-modified, and C overlap with several existing water rights. There is one known water right in the Piper Mountain Addition under alternatives B, B-modified and C, and seven additional known water rights under alternative C within the Ansel Adams, Deadman Canyon, and Marble Creek Additions. Existing valid water rights would not be negatively impacted since they would be allowed to continue in the recommended wilderness areas. There would be minimal impacts to wilderness character as long as these water rights would not require motorized or mechanized access or maintenance.

There may be a special use facility for a utility company's water diversion intake in alternatives B, B-modified and C in the South Sierra Wilderness Addition East (1). Under alternative C, there may be up to 28 water-related special use facilities that are within wilderness additions. Some of these facilities may only be in a proposed status and may not actually exist. These existing special use developments would not be adversely impacted since they would be allowed to continue as long as access and maintenance follow wilderness direction and policy, which generally means nonmechanized and nonmotorized access and maintenance. Although these special use facilities would not improve wilderness character, they would only minimally affect the undeveloped quality of wilderness character where facility structures could be observed. The tradeoff would be that wilderness designation could increase the cost and complexity of maintaining those facilities because of the need to access by foot or horse and use nonmechanized means of maintenance. As a result, the annual operating costs to the current permittee would have the potential to increase under these conditions, to the greatest extent in alternative C. The extent of these potential cost increases is uncertain at this programmatic level.

There is one known existing wildlife guzzler in alternatives B, B-modified and C within the recommended Piper Mountain (1) Addition. Another four known guzzlers are in areas that are recommended for wilderness only in Alternative C. In both alternatives the existence of guzzlers would be not be adversely affected since existing uses can remain intact and there are plan components and standards (MA-RWLD-DC and MA-RWLD-STD) that would minimize impacts related to existing infrastructure in recommended wilderness. While guzzlers themselves may not be considered inconsistent with recommended wilderness management, the motorized access and mechanized means to maintain guzzlers would not be allowed in the recommended wilderness areas unless otherwise authorized under a minimum requirements decision. If not authorized, maintenance of guzzlers could prove more difficult under these conditions and could negatively impact the future conditions of the guzzlers. This would be a more substantial impact in alternative C since maintaining five guzzlers could prove difficult and costly, and somewhat minimal under alternatives B and B-modified since maintaining one guzzler under these conditions would be feasible. Deteriorated guzzler conditions could occur under Alternative C which could ultimately negatively impact wildlife that depends upon these guzzlers as well as hunting opportunities for large game.

The existence of the guzzlers in recommended wilderness would be a minimal impact to wilderness character since they are low profile and typically underground. There would be short-term impacts on the undeveloped quality of wilderness if motorized access or mechanized maintenance was authorized under a minimum requirements decision; and these short-term impacts would likely happen on an annual basis during needed maintenance activities.

Under alternatives B, B-modified, and C there is a private inholding within the White Mountains Wilderness Additions (West). Under Alternative C there is an additional private inholding in the Glass Mountain Addition. Existing inholdings would not be negatively impacted since the use would be allowed to continue in the recommended wilderness areas. There would be minimal impacts to wilderness character as long as the inholdings do not require motorized or mechanized access.

There are two existing grazing allotments within recommended wilderness polygons in alternatives B, B-modified, and C; one within the White Mountains Additions (East) and one within the South Sierra Wilderness Addition – East (1). There are no permitted structures or improvements associated with these allotments, only grazing activities. Under alternative C there is one additional grazing allotment with no improvements and three grazing allotments with improvements. There would be no adverse impacts to any of these allotments since existing grazing use would be allowed to continue in recommended wilderness. There may be economic impacts on the allotments as a result of the requirement for nonmotorized and nonmechanized access and maintenance, which are also discussed under the “Forest Benefits to People and Communities” section, “Economic Conditions.” Overall, this change in access would prohibit motorized vehicle use for maintenance of stock water developments, salt placement and restrict installation of new range improvements (such as water troughs) unless approved following a minimum requirements decision. Overall, the annual operating costs to the current permittees would be expected to increase under these conditions. Given the acreages identified for recommendation in each alternative, the adverse effects under alternative C, if designated by Congress, would be greater than alternatives B and B-modified. The extent of these effects is uncertain at this programmatic level.

There would be minimal impacts to wilderness character from the three allotments without improvements if these allotments are monitored and administered to standards that protect wilderness character. Grazing would impact aspects of solitude, however, this impact would be considered minimal given that existing grazing activities are permitted under the Wilderness Act, so the public is accustomed to this use. The existing developments under the three grazing allotments in alternative C would have impacts to the undeveloped qualities of wilderness character, but these impacts would be relatively small since they would not be modern improvements, but more traditional developments like troughs and fences.

Under alternatives B, B-modified, and C, tribal activities could still occur within areas recommended as wilderness. Some tribal activities such as gathering and ceremonial uses could become more restricted, to the greatest extent under alternative C, but no motorized routes were included in any of the recommended wilderness areas, therefore all authorized motorized access would remain to cultural sites and gathering areas. Potential impacts to gathering and ceremonial uses would be minimized since revised forest plan direction ensures that management plans for wilderness areas would include tribal perspectives (TRIB-FW-DC-01) and attempt to incorporate traditional ecological knowledge (TRIB-FW-DC-04) and associated traditional practices (TRIB-FW-DC-03). Impacts to tribal uses is discussed in greater detail in the "Tribal Relations and Uses" section, Environmental Consequences.

Consequences Specific to Alternative C

There are several existing outfitter and guide special use permits under three of the proposed wilderness additions in alternative C. These outfitter and guides operate under special use permit for activities such as hunting and backpacking. Management direction in the revised forest plan would not allow commercial enterprise unless it is specifically allowed under the Wilderness Act. The Wilderness Act does not prohibit outfitter and guides; however, it must be wilderness dependent in order to be appropriate. Recommended wilderness areas would negatively impact outfitter and guide activities only if those activities become prohibited as a consequence of wilderness designation. The outfitter and guide activities, if found appropriate, could continue and would not be negatively impacted. The outfitter and guide activities could have potential negative impacts on opportunities for solitude in the recommended wilderness areas if visitor use increases during outfitter and guide activities in recommended wilderness.

Under alternative C there is one known active mining claim within the Pizuna-Truman Meadows addition. There is also an old mining site in the Marble Creek Addition where some mining activity may still occur. Mining operations could continue on valid existing mining claims after wilderness designation, as long as wilderness characteristics are protected. Mechanical transport, motorized equipment, and access to utility corridors may be used after a determination that they are the minimum necessary. Use of mechanical transport or motorized equipment would likely affect the wilderness character. As long as these uses were allowed to continue there would be no impact to the mining claim.

Under alternative C there are six wilderness additions that include wild horse management areas. In order to effectively manage these areas for wild horses, there could be a need to use helicopters and install fences and corrals in the future inside the recommended wilderness areas if approved under a minimum requirements decision. Management activities that require permanent improvements would likely have negative impacts on maintaining wilderness character; however, if the improvements were temporary, this could ensure that impacts to wilderness character would only be short term. If helicopter access is needed it would impact the undeveloped qualities of wilderness character and opportunities for solitude, but the impacts would be short term in nature and not a long term impact.

Cumulative Effects

Reasonable and foreseeable actions on National Forest System lands include vegetation management, mining, recreation use, and reduction of fuels in the wildland-urban intermix. These actions could impact the wilderness characteristics of solitude, depending on how close and pervasive the actions are, although typically just sights and sounds within the recommended wilderness area are considered when determining effects to wilderness characteristics. For example, vegetation management activities such as timber harvesting adjacent to recommended wilderness area may increase the sights and sounds of logging equipment such as chainsaws and mechanized equipment within the recommended wilderness area, but because it is outside of the recommended wilderness area, it is not considered to degrade the wilderness characteristic of solitude. However, an expansion of a developed recreation site adjacent to recommended wilderness could increase use levels within the recommended wilderness, which may result in cumulative impacts to solitude as the number of encounters with others could increase within the recommended wilderness area.

Population growth in California and Nevada is likely to increase recreation use of the Inyo National Forest including an increase in use within recommended wilderness. The effects of urbanization and population growth on recommended wilderness use and resource conditions are likely to be gradual and to extend well beyond the planning period. Increased recreation use may negatively impact wilderness characteristics, particularly the opportunity for solitude and natural quality. Examples of potential impacts include increased opportunity for crowding in certain locations, soil compaction or erosion, and threats to native plant species from the spread of noxious weeds from sources outside the wilderness.

Analytical Conclusions

Alternatives B, B-modified, and C recommend additional areas for inclusion in the National Wilderness Preservation System. Alternatives B, B-modified, and C also include plan direction that would protect the values that make the areas suitable for wilderness designation. Areas managed as recommended wilderness would be unsuitable for motorized and mechanized transport (mountain bikes) and would limit future development of mountain bike and off-highway vehicle recreation opportunities. There would be a slight decrease in motorized recreation opportunity settings in alternatives B and B-modified from the current plan (alternative A) due to the change in recreation opportunity spectrum settings; however, this impact is considered negligible since it would not result in any closures of motorized routes. Alternative C would have the greatest decrease in motorized recreation opportunity settings. Mechanized activities (mountain bikes) would also be the most affected under alternative C where recommended wilderness areas have existing trails open to mechanized transport. Alternatives B and B-modified would have the least impacts on mechanized and motorized opportunity settings while still having beneficial ecological and social benefits as a result of the four recommended wilderness areas.

Alternatives B and B-modified would also result in expanded wilderness recreation opportunities for nonmotorized users seeking opportunities for solitude. Alternative C would have the most beneficial effect on nonmotorized recreation opportunity settings by providing increased opportunities for solitude through its 24 recommended wilderness additions. Although alternative C provides the highest amount of ecological and social benefits through the recommended additions, managing the additional acreage and multitude of other uses that occur in the additions would present management challenges for recreation management, fire and fuels management, and wildlife management. Although alternative C offers the largest blocks of undisturbed habitat, it also has the greatest potential for loss of habitat structure important to at-risk species due to increased potential for large wildfires (see “Terrestrial Vegetation Ecology” section). Alternatives B and B-modified strike a balance between ecological and social benefits, and the Inyo’s ability to adequately manage these areas while ensuring wilderness character is maintained.

Since there are no new recommended wilderness areas under alternatives A and D, this would allow the Inyo staff to focus on management of existing wilderness areas and a full suite of management tools would be available to conduct fuels and fire management in both alternatives; and a focus on restoration activities in alternative D. In the absence of wilderness recommendations in alternative D, this provides the greatest opportunity of all alternatives for an increased pace and scale of mechanical restoration treatments, prescribed burning, and managing wildfires to meet resources objectives proposed in this alternative. However, without recommended wilderness in either of these alternatives, there would no long-term social or ecological benefits derived from recommending new wilderness areas. Although alternative D meets resource objectives, it fails to strike a management balance where desired conditions for restoration activates are met, but the ecological and social benefits of recommended wilderness areas are also considered.

Large-scale fuels treatments and forest habitat restoration activities would be more limited in areas recommended for wilderness in alternatives B and B-modified, due to the management challenges of working in wilderness, but fire, fuels and habitat management objectives could still be achieved using prescribed burning and nonmechanized methods within recommended wilderness areas. Management limitations would be greatest challenge in alternative C and may hinder the Inyo's ability to achieve fire, fuels, restoration, and habitat management objectives. Alternatives B and B-modified have a mix of fire management zones in the recommended wilderness areas which take into account fire risk to communities and meeting resource objectives. Alternative B would better meet desired conditions for maintaining and enhancing wilderness character; however, alternative B-modified still has beneficial impacts to maintaining wilderness character. Alternative C includes a substantial portion of the recommended wilderness in the general wildfire zone where there is a wide range of fire risk. Limitations on the use of mechanized equipment would make it difficult to manage some wildfires to meet resource objectives due to the existing levels of fuels within recommended wilderness areas coupled with fewer areas of fuel reduction between wilderness and communities. This could result in negative impacts to wilderness character and would not achieve desired conditions for fire and fuels management.

Eligible and Suitable Wild and Scenic Rivers

Background

The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Wild and Scenic Rivers Act,[41] which established the system, is notable for safeguarding the special character of these rivers, while recognizing the potential for their appropriate use and development. It encourages river management that crosses political boundaries and promotes public participation in developing goals for river protection.

The 2012 Planning Rule requires the Forest Service to conduct an inventory of rivers and determine wild and scenic river eligibility and classification during land and resource management plan development or revision as outlined in the Wild and Scenic Rivers Act. Section 5(d)(1) of the rule states:

> In all planning for the use and development of water and related land resources, consideration shall be given by all federal agencies involved to potential national wild,

[41] Public Law 90-542; 16 U.S.C. 1271 et seq.

> scenic and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss any such potential. The Secretary of the Interior and the Secretary of Agriculture shall make specific studies and investigations to determine which additional wild, scenic and recreational river areas within the United States shall be evaluated in planning reports by all federal agencies as potential alternative uses of the water and related land resources involved.

The Planning Rule specifically requires that during plan development or revision, river eligibility must be identified unless an inventory has been completed and no changed circumstances or new information warrant further review. The rule also requires the Forest Service to manage those eligible and suitable rivers to protect the values that support their inclusion in the National Wild and Scenic River System until Congress makes a final determination on their designation.

Analysis and Methods

The process used to identify and evaluate rivers for their potential eligibility is found in the Forest Service Land Management Planning Handbook 1909.12, chapter 80. This will be referred to as the Wild and Scenic Rivers Evaluation Handbook. This chapter of the handbook contains guidance and instruction the agency must use to carry out the direction contained in the Planning Rule.[42] Additional guidance can be found in the Interagency Wild and Scenic Rivers Coordinating Council technical paper: The Wild & Scenic River Study Process (1999).

The evaluation process includes a sequence of four steps, three of which are required during plan revisions. The Wild and Scenic Rivers Handbook directs interdisciplinary teams to complete the evaluation of rivers to be studied for eligibility, considering best available scientific information and public input. The four steps include:

1. **Inventory:** The staff at each national forest must develop a systematic and comprehensive inventory of rivers to consider for their potential eligibility. Unless a previous systematic inventory of study rivers has been completed and eligible rivers identified, a comprehensive inventory will be developed to evaluate which rivers are eligible for inclusion in the National Wild and Scenic River System. If a systematic inventory of eligible rivers has been completed, the extent of the study process during plan development or revision can be limited to evaluation of any rivers that were not previously evaluated for eligibility and those with changed circumstances.
2. **Eligibility determination:** The next step is to determine stream eligibility for inclusion in the National Wild and Scenic Rivers System. To be eligible for designation, a river or stream must be free-flowing and possess one or more "outstandingly remarkable values." Thus, the eligibility analysis consists of an examination of the river's hydrology, including any man-made alterations, and an inventory of its natural, cultural, and recreational resources.
3. **Classification:** After the Forest Service determines if a river or portions of a river are eligible, each inventoried segment is then assigned a preliminary classification of "wild," "scenic," or "recreational." Classification is based on the level of human development of the shoreline, watercourse, and access at the time a river is found eligible.
4. **Suitability:** The fourth step, suitability, may happen during forest plan revision but is not required. A suitability study provides the basis for determining which rivers to

[42] 36 CFR 219.7(vi)

recommend to Congress as potential additions to the national system. This analysis and decision-making step will not be completed as part of the current forest plan revision process for the Inyo National Forests but will be completed in a future separate National Environmental Policy Act environmental review process.

The detailed steps that were used to develop the inventory for the evaluation (step 1) and the eligibility of rivers in the inventory (step 2) are described in appendix C: Wild and Scenic River Evaluation for the Inyo National Forest in the section titled “Process to Identify Rivers to be Considered for Eligibility for Inclusion in the National Wild and Scenic Rivers System.” Additionally, in the “Results of the Evaluation” section of appendix C, the process is further explained.

Indicators and Measures

The indicator for wild and scenic rivers is total miles of newly eligible rivers versus reaffirmed eligible rivers by classification.

Under current management, rivers that were identified as eligible for inclusion in the National Wild and Scenic Rivers System in previous river studies have been, and will continue to be, managed to protect their eligibility until such time as suitability can be completed. During the current comprehensive wild and scenic river evaluation, additional rivers have been determined to be eligible. This indicator identifies the increase between what is currently being managed as eligible and what would additionally be managed as eligible as a result of the current wild and scenic river evaluation.

Affected Environment

The Inyo National Forest currently manages a total of approximately 90 miles of designated wild and scenic rivers. The extent of the National Wild and Scenic Rivers System currently includes approximately 12,708.8 miles of 208 rivers designated by Congress in 39 states and the Commonwealth of Puerto Rico; this is a little more than one-quarter of 1 percent of the nation's rivers. The National Wild and Scenic Rivers System is managed by the Forest Service, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and portions of the National Wild and Scenic River System are also managed by states as shown in table 94 below.

Table 94. Total miles of rivers in the National Wild and Scenic River System by managing entity and classification, nationwide

Entity	Wild Classification	Scenic Classification	Recreational Classification	Total
Forest Service	1,735.1	1,300.7	1,923.6	**4,959.4**
Bureau of Land Management	1,531.2	352.4	541.6	**2,425.2**
National Park Service	1,739.2	745.9	735.6	**3,220.7**
U.S. Fish and Wildlife Service	1,043.0	8.0	0	**1,051.0**
States	139.4	343.9	569.2	**1052.5**
Total	**6,187.9**	**2,750.9**	**3,770**	**12,708.8**

In California there are 23 designated wild and scenic rivers for a total of 1,999.6 miles, and the Forest Service manages about 69 percent of the total miles of designated wild and scenic rivers in California. The other 31 percent of wild and scenic rivers are managed by the Bureau of Land Management and the National Park Service.

There are three designated wild and scenic rivers on the Inyo National Forest (see maps in volume 4). These rivers are included in the total mileage listed above of wild and scenic rivers in California (1,999.6 miles).

- The **Cottonwood Creek Wild and Scenic River** is 21.5 miles total length and is managed jointly with the Bureau of Land Management (BLM) with 17.4 miles on the Inyo National Forest and 4.1 miles on Bureau of Land Management-managed lands. This river was added to the National Wild and Scenic Rivers System in 2009.
- The **Kern Wild and Scenic River** is 151 miles total length and is managed jointly by the Inyo National Forest, Sequoia National Forest, and Sequoia and Kings Canyon National Parks with 124 miles on the national forests and 27 miles in Sequoia and Kings Canyon National Parks. This river was added to the National Wild and Scenic Rivers System in 1987.
- The **Owens River Headwaters Wild and Scenic River** is 19.5 miles total length and is managed by the Inyo National Forest. This river was added to the National Wild and Scenic Rivers System in 2009.

There is one river that has been found to be suitable in previous wild and scenic river studies and have previously been recommended by the Forest Service for inclusion in the National Wild and Scenic River System. This river will continue to be managed as “recommended” wild and scenic rivers until a decision through an Act of Congress is made.

- The **Middle Fork San Joaquin Recommended Wild and Scenic River** is 22 miles from its headwaters at Thousand Island Lake to the Confluence with the North Fork San Joaquin River. Segment 1 (6 miles) and segment 2 (4.5 miles) are managed by the Inyo National Forest, segment 3 (2.5 miles) is jointly managed by the Inyo National Forest and Devil’s Postpile National Monument, and segment 4 (9 miles) is managed by the Inyo and Sierra National Forests.

Environmental Consequences to Eligible and Suitable Wild and Scenic Rivers

Resource Protection Methods

The 2012 Planning Rule specifically requires the Forest Service to manage those rivers that are found to be eligible and suitable to protect the values that provide the basis for their inclusion in the National Wild and Scenic River System until Congress makes a final determination on their designation. It requires that the forest plan provide plan components, including standards and guidelines, to provide for the protection of designated wild and scenic rivers as well as management of rivers found eligible or determined suitable for the National Wild and Scenic River system to protect the values that provide the basis for their suitability for inclusion in the system.[43]

The Forest Service Handbook 1909.12, chapter 80, section 84.2 states,

> A Responsible Official may authorize site-specific projects and activities on National Forest System lands within eligible or suitable river corridors only where the project and activities are consistent with all of the following:

[43] 36 CFR 219.10

a) The free-flowing character of the identified river is not adversely B-modified the construction or development of stream impoundments, diversions, or other water resources projects.

b) Outstandingly remarkable values of the identified river area are protected.

c) For all Forest Service-identified study rivers, classification of an eligible river must be maintained as inventoried unless a suitability study is completed that recommends management at a less restrictive classification (such as from wild to scenic or scenic to recreational).

Any site-specific projects and activities that a responsible official authorizes on National Forest System lands within Forest Service-identified eligible or suitable river corridors must also be consistent with the interim protection measures outlined in section 84.3 of the handbook. These interim protection measures have been incorporated into the revised forest plan for the Inyo National Forest. These measures are the same in all plan revision alternatives, and only differ from alternative A. Additionally, the set of plan components developed for other aspects of the plan, such as riparian area plan components, will likely also provide for management of eligible and suitable rivers consistent with some parts of the interim protection measures. The eligible corridors include one-quarter mile from the normal high-water mark on each side of the river.

Consequences Common to all Alternatives

A total of 1,224.6 miles of river were included in the current inventory that was evaluated for wild and scenic river eligibility by the Inyo National Forest. Of that inventory, 245.5 miles of river had been evaluated in previous efforts and 128.3 miles had previously been determined to be eligible and have been managed to protect their eligibility. Of those eligible rivers, 70.9 miles were assigned a preliminary classification of wild, approximately 9.7 miles were assigned a preliminary classification of scenic, and 47.7 miles were assigned a preliminary classification of recreational (see table 95).

The current effort included development of a comprehensive inventory of rivers on the national forest. Rivers that had been previously evaluated for eligibility in earlier efforts were given a refreshed look to determine if there were any changed conditions or new information, and findings were adjusted accordingly. As shown in table 95, of the 128.3 miles that had previously been determined to be eligible, 124.4 miles were reaffirmed as eligible and 4.3 miles were determined not eligible. An additional 15.6 miles was determined to be eligible from previously studied inventory. Classifications were reviewed and adjusted if changed conditions were present. The updated classification findings on the previously evaluated rivers determined approximately 74.9 miles were assigned a preliminary classification of wild, approximately 5.8 miles were assigned a preliminary classification of scenic, and 59.4 miles were assigned a preliminary classification of recreational, bringing the total number of miles of eligible rivers from previous inventory to 140.1 miles.

New inventory was evaluated to determine if free flow and any outstandingly remarkable values were present. Of the 979.1 miles of new inventory that were evaluated for eligibility, approximately 101.1 new miles were determined to be eligible. The classification findings on the newly evaluated rivers determined approximately 56.6 miles were assigned a preliminary classification of wild, 8.7 miles were assigned a preliminary classification of scenic, and 35.8 miles were assigned a preliminary classification of recreational. The detailed results of these evaluations can be viewed in “Appendix C: Wild and Scenic River Evaluation for the Inyo National Forest.” The total miles of river currently determined to be eligible for inclusion in the

National Wild and Scenic Rivers System is approximately 241.2 miles (based upon 140.1 miles of updated miles of previously studied rivers and 101.1 miles of new inventory). The past and current findings from evaluations are summarized in table 95.

Table 95. Comparison of past and current wild and scenic river eligibility review findings in miles for the Inyo National Forest

Miles	Past Wild and Scenic Eligibility Review Findings	Updated Findings on Previously Evaluated Rivers	Findings for New Inventory Evaluated for Wild and Scenic Eligibility	Total Updated Findings	Change from Current Wild and Scenic Evaluation
Inventoried	245.5	245.5	979.1	1,224.6	+979.1
Total Found Eligible	128.3	140.1	101.1	241.2	+112.9
Preliminary Classification: **Wild**	70.9	74.9	56.6	131.5	+60.6
Preliminary Classification: **Scenic**	9.7	5.8	8.7	14.5	+4.8
Preliminary Classification: **Recreational**	47.7	59.4	35.8	95.2	+47.5

None of the alternatives in the revised plan would be expected to have negative impacts on eligible wild and scenic rivers. The interim protection measures that have been incorporated into the revised forest plan would protect the free-flowing character and the identified outstandingly remarkable values for all eligible rivers. In addition, there are other aspects of the plan, such as riparian area plan components, which would likely also provide for the protection of the free-flowing character and associated outstandingly remarkable values for both eligible rivers. It is not anticipated that there would be adverse impacts on the Inyo's ability to conduct management activities within the new eligible river sections since a significant portion of those wild portions of are within existing wilderness and would be managed in a similar manner.

Cumulative Effects

Additional eligible rivers may be identified in existing or future planning efforts or through separate river studies on adjacent national forests and for other agencies (Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service) that manage the National Wild and Scenic Rivers System. There would be no negative cumulative effects expected to occur on designated or eligible wild and scenic rivers as a result of any of the alternatives.

Analytical Conclusions

For the Inyo National Forest, the required wild and scenic evaluation process resulted in 88 percent (112.9 miles) increase in the miles of river determined to be eligible. The results of the classification findings show a 85.4 percent (60.6 miles) increase in the miles of eligible rivers that will be managed as wild, a 49.5 percent (4.8 miles) decrease in the miles of eligible rivers that will be managed as scenic and an 99.6 percent (47.5 miles) increase in the miles of eligible rivers that will be managed as recreational. In all plan revision alternatives, the interim protection measures that have been incorporated into the revised forest plan would protect the free-flowing character and the identified outstandingly remarkable values for all eligible rivers. Direction in the revised plan for all alternatives ensures that any project level planning in these eligible river corridors will be consistent with their preliminary classification and protect the values that provide the basis for their inclusion in the National Wild and Scenic River System until such time as a negative suitability determination is made or Congress makes a final determination on their designation.

Since the more than half of the increase in eligible miles are classified as wild and occur in areas designated as wilderness, there would be little to no effect on other activities as a result of the eligibility and classification findings compared to how these areas have been managed in the past. The increase in the miles of eligible rivers that would be managed as recreational and scenic would likely have negligible effects on other management activities when the benefits of protecting the free-flowing character of these rivers and outstandingly remarkable values are considered.

Pacific Crest National Scenic Trail

Background

The National Trail System is composed of 30 congressionally designated trails (11 national scenic trails and 19 national historic trails), which stretch for a hundred or thousands of miles each and more than 55,000 miles in total. National scenic and historic trails traverse wilderness, rural, suburban, and urban areas in 49 states connecting with every distinct ecological area or biome in the U.S. They protect crucial conservation areas and provide wildlife migration corridors, as well as education, recreation, and fitness for people of all ages.

The Pacific Crest National Scenic Trail was designated in 1968 by Congress as one of the original national scenic trails. The National Trails System Act[44] directed that these long distance trails provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass. Citizen stewardship and volunteerism were recognized in the Act and have been an integral component of the planning, management, and maintenance of the trail.

Beginning in southern California at the Mexican border, the Pacific Crest Trail travels 2,650 miles through California, Oregon, and Washington until reaching the Canadian border figure 33. First conceived in the 1930s, the trail traverses the highest elevations of the Sierra and Cascade mountain ranges and was designed to include portions of the historic John Muir and Skyline Trails. The Pacific Crest Trail is considered one of the most remote long distance trails with over 54 percent of its path in designated wilderness. Oriented in a north-south direction, the Pacific Crest Trail is the only completed west coast national scenic trail.

[44] Public Law 90-543

Figure 33. The Pacific Crest National Scenic Trail

The selected route location for the Pacific Crest Trail was published in the Federal Register on January 30, 1973. The route traverses portions of 25 national forests, six national parks, seven Bureau of Land Management Field Offices, five national monuments, one national scenic area, as well as, state and private lands in the states of California, Oregon, and Washington. The Regional Forester of the Pacific Southwest Region is the lead official for coordinating matters concerning the study, planning, and operation of the Pacific Crest Trail (Forest Service Manual 2353.04).

The “Pacific Crest National Scenic Trail Comprehensive Plan” was signed by the Chief of the Forest Service in 1982 and set forth direction to guide the development and management of the Pacific Crest Trail (USDA Forest Service 1982). The Pacific Crest Trail Corridor is administered consistent with the nature and purposes for which this National Scenic Trail was established—to provide for high-quality scenic, primitive hiking and horseback riding opportunities, and to conserve natural, historic, and cultural resources along the corridor.

The Comprehensive Plan directed that each "National Park, Bureau of Land Management District and National Forest will integrate the direction and guidance provided by the Comprehensive Plan into their respective land management planning processes." Executive Order No. 13195, Trails for America in the 21st Century (2001), recognized the importance of "Protecting the trail corridors associated with national scenic trails …to the degrees necessary to ensure that the values for which each trail was established remain intact." The National Trails System Act (section 7(a)) directs that management of each segment of the National Trails System shall be designed to harmonize with and complement any established multiple-use plans for the specific area in order to insure continued maximum benefits from the land.

The Pacific Crest Trail Association, a 501(c)(3) nonprofit, is recognized as the Federal Government's major partner in managing and maintaining the Pacific Crest Trail. The tenants of the U.S. Forest Service, Bureau of Land Management, National Park Service and the Pacific Crest Trail Association's relationship are outlined in a memorandum of understanding (2015).[45] The Pacific Crest Trail Association serves to recruit, train, and supervise volunteers to assist with trail management and maintenance. The collaborative work focuses on engaging youth and developing citizen stewardship, providing quality recreation experiences for hikers and equestrians, and ecosystem restoration and is funded, in part, through cooperative agreements with federal agencies.

Analysis and Methods

Analysis Area

Pacific Crest Trail recreationists have three distinct travel use patterns:

1. **Day use:** The largest user group, these travelers typically originate from within a 75-mile (1.25 hour driving time) radius of the Pacific Crest Trail.
2. **Section use:** The second largest user group, these travelers typically live on the west coast in one of the three states the trail travels through; and
3. **Entire trail:** These thru-hikers and equestrians have a broad geographic draw from across the United States and abroad and share the goal of completing the entire trail.

The analysis area for the Pacific Crest Trail Corridor considers local, regional, and national scales based on the unique and distinctive role and contributions the trail plays in providing recreation opportunities for day, section, and trailwide use in three states and across numerous public land entities.[46]

Methods

To identify the management area boundaries for each alternative, a geographic information systems model was constructed with the following criteria (see maps in volume 3).

- Alternative A: Established based on mileage of trail multiplied by 6 feet in width (general trail clearing width for 24-inch trail with packstock).

[45] Memorandum of Understanding between USDA Forest Service, National Park Service, Bureau of Land Management California and Oregon/Washington State Offices, California State Parks and the Pacific Crest Trail Association, May 21, 2015.

[46] Forest Service Handbook 1909.12, chapter 20, section 22.32 3(f)

- Alternatives B and B-modified: Established using what topography is seen from the trail platform at eye-level (5 feet height) up to one-half mile of centerline (foreground).
- Alternative C: Established using alternative B plus the Scenic Attractiveness A inventory layer up to 4 miles (middleground).
- Alternative D: Established using one-quarter mile management area from centerline of the trail.

In this section, key components for the environmental consequence analysis for the Pacific Crest Trail are based on the scenic and recreation resources. The recreation opportunity spectrum provides for the varied recreation opportunities along the trail in terms of setting, activity, and experience (USDA Forest Service 1982).

Scenic resources are analyzed based on scenic integrity objectives and distance zones (USDA Forest Service 1995b). Scenic integrity objectives range from very high to low. Distance zones are defined as foreground, middleground, and background. Foreground views are considered to be those within approximately one half-mile of the viewer; middleground views are views of objects or scenic resources between approximately one half-mile and four miles away from the viewer; background views are views that extend beyond four miles from the viewer, to the horizon.

Indicators and Measures

Acres allocated to Pacific Crest Trail corridor by alternative within designated wilderness and outside of designated wilderness: The total number of acres within the management area is a measure of the amount of surrounding area or trail corridor that provides for high-quality scenic, primitive hiking, and horseback riding opportunities, and conserves natural, historic, and cultural resources.

Acres within the Pacific Crest Trail corridor allocated to each recreation opportunity spectrum class by alternative: The number of acres of each recreation opportunity spectrum class in the management area displays the emphasis on recreation activities, setting, and experience ranging from primitive to urban.

Acres within the Pacific Crest Trail corridor by alternative allocated to scenic integrity objectives: Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances from human activities or extreme natural events outside of the natural range of variation. The number of acres in the management area of each scenic integrity objective displays the overall plan for the scenery surrounding the trail to have a natural appearance.

Miles of motorized roads and trails and number of crossings of Pacific Crest Trail in the Corridor: Motorized use is prohibited on the Pacific Crest Trail. The miles of motorized roads and trails within the corridor and crossing the Pacific Crest Trail displays the amount and proximity of motorized use within the corridor.

Assumptions

- Of the scenery management distance zones, details are more easily seen from foreground and middle ground, which usually has the most visual sensitivity (USDA Forest Service 1995b).

- The forest plan does not make site-specific decisions regarding travel management within the Pacific Crest Trail Management Area. No roads or trails would be opened or closed in this forest plan decision.
- The more acres within the Pacific Crest Trail Management Area the higher the protection of the resources, qualities, values, associated settings, and the primary uses of the Pacific Crest National Scenic Trail.

Affected Environment

Recreation Opportunity

Trailwide: The Pacific Crest Trail is a long-distance trail that is designed with a native surface tread to meet pack and saddle "more difficult" design and maintenance standards for most of its length. Rustic bridges constructed of native materials may be provided where needed for resource protection or to accommodate those users with a moderate skill level. Trailwide, the Pacific Crest Trail is open to foot and horse travel and closed to motorized[47] and mechanized travel.[48]

The current Inyo Forest Plan recognized the Pacific Crest National Scenic Trail, and defined visual management standards and guidelines, but did not define a trail corridor or identify other desired conditions, resources, qualities, or values to be specifically managed.

There are locations along the Pacific Crest Trail where the trail has been located on an interim route in order to have a continuous path from Mexico to Canada. On private lands, over 300 miles of trail is under easement that may be as narrow as 10 feet and are typically insufficient to provide the optimal recreation opportunities and protect the scenic values of the trail. These temporary locations may be along motorized road shoulders or motorized trails with the long-term objective of relocating the trail to an optimal nonmotorized location.

Management of the Pacific Crest Trail Corridor is designed to harmonize with and complement established multiple-use plans to ensure continued benefits from the lands. To the extent practicable, efforts are made to avoid activities incompatible with the nature and purposes of the trail.[49] Managers protect the integrity of the trail by avoidance, mitigation, and modifying management practices as needed.

Inyo National Forest: The Inyo National Forest manages 86 miles of the Pacific Crest Trail. Ninety-four percent of this mileage on the Inyo is located within designated wilderness, including the South Sierra, Golden Trout, John Muir, and Ansel Adams Wildernesses. Table 96 displays the number of miles[50] of the Pacific Crest Trail within designated wilderness, and by activities outside of wilderness. The Inyo National Forest has 592 miles of trail outside of wilderness with 57 percent of those trails open to motorized use and 99 percent open to bicycle use. The sixty-five percent of the national forest is in the nonmotorized settings of primitive or semi-primitive nonmotorized (see "Sustainable Recreation," Affected Environment, Recreation Setting section). The Inyo National Forest is open to motorized and nonmotorized winter recreation activities. Currently over-snow vehicles are allowed on routes and open areas outside of designated

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[47] 36 CFR 261.20

[48] Regional Order 88-4 and 36 CFR 212.21

[49] National Trails System Act (Pub.L. 90–543 Sec. 7(a) and (c) , 82 Stat. 919, enacted October 2, 1968), codified at 16 U.S.C. § 1241 et seq

[50] Miles of "standard terra" trails, which have a surface consisting predominantly of the ground and are designed and managed to accommodate use on that surface. It does not include snow or water trails.

wilderness (see "Sustainable Recreation," Affected Environment, Recreation Opportunities section).

Table 96. Number of miles of Inyo National Forest System trails and miles of Pacific Crest Trail within and outside of designated wilderness

Inyo National Forest	Total Trail Miles	Wilderness Trail Miles	Nonwilderness Trail Miles	Nonwilderness Trail Miles Open to Motorized Use	Nonwilderness Trail Miles Open to Bicycle Use
Pacific Crest Trail	86	83	3	0	0
All Trails	1,669	875	794	342	564

Visitor Use

Trailwide: There are numerous points of entry for the Pacific Crest National Scenic Trail as it travels 2,650 miles through 25 national forests, 7 Bureau of Land Management Field Offices, and 6 national parks (and 48 wilderness areas); therefore obtaining total monthly or annual trail user numbers on all parts of the Pacific Crest Trail has been cost prohibitive. The largest segment of the Pacific Crest Trail users is day hikers. Since the trail is within two hours travel time from the metropolitan centers of San Diego, Los Angeles, Sacramento, Portland, and Seattle, there is a high demand for day and weekend use. Interest in long-distance hiking of the Pacific Crest Trail has been increasing in the past years, and the trend is expected to continue. The New York Times Bestseller book by Cheryl Strayed, *Wild: From Lost to Found on the Pacific Crest Trail* (Strayed 2012) and subsequent movie has increased the interest in the Pacific Crest Trail from a broad audience. Visitor use management is the proactive and adaptive process of planning for and managing characteristics of visitor use and its physical and social setting, using a variety of strategies and tools, to sustain desired resource conditions and visitor experiences.

Both section users (traveling greater than 500 miles) and entire trail users on the Pacific Crest Trail receive a permit, and the numbers of permits issued in the past two years are shown in table 97. Successful completion of the entire length of the trail in one season is highly dependent of snow conditions and wildfire activity. Table 97 shows that 2016, the highest number of all total permits issued was 5,657. Completion rate for thru-travelers in 2016 was 29 percent of permits issued[51]. The attrition rate and distribution has not been further analyzed to account for travelers never using the permit or the locations where trips ended.

Table 97. Section and thru-hike permits issued for the Pacific Crest Trail 2013-2016

Year	Total Number of permits issued	Northbound thru-hike permits	Southbound thru-hike permits	Section hike permits	Thru-ride permits	Section ride permits	Completions reported
2013	1,879	988	53	834	1	3	271[1]
2014	2,655	1,367	94	1,179	7	8	472
2015	4,453	2,486	322	1,633	4	8	478
2016	5,657	3,164	334	2,159	5	8	701

1. Low number of completions likely due to early season snowfall.

[51] See the Pacific Crest Trail Association Website at: https://www.pcta.org/our-work/trail-and-land-management/pct-visitor-use-statistics/.

In 2016, 17 percent of the permits issued were to international travelers from 34 countries with the most number from Canada, Germany, and the United Kingdom, respectively. The majority of the permits (83 percent) were to recreationists originating from the United States represented by all 50 states and the District of Columbia, with the most number being issued to California, Washington, and Oregon state residents, respectively.

Within the southern Sierra, land managers within Inyo National Forest, Sierra National Forest and Yosemite and Sequoia and Kings Canyon National Parks are monitoring increased visitor use on the John Muir Trail and the Pacific Crest Trail. On the Inyo, the Pacific Crest Trail and the John Muir Trail are the same trail in several trail sections.

Figure 34 shows from 2011 to 2016 there has been a 242 percent increase in John Muir Trail visitor use permits issued. Yosemite National Park implemented an exit quota permit system in 2016 to address access and resource concerns related to increased use.[52]

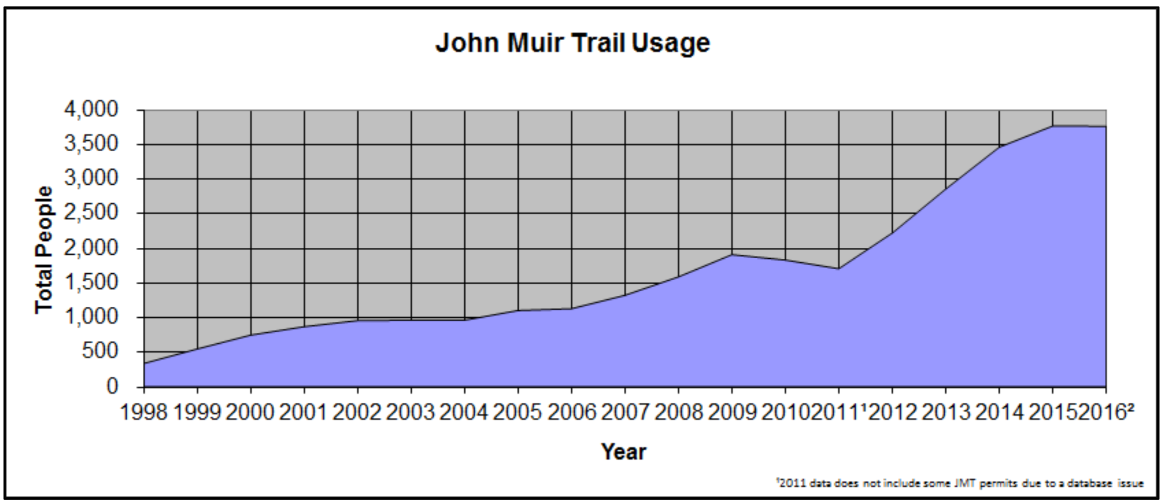

Figure 34. John Muir Trail usage (which uses the same trail tread as the Pacific Crest Trail for most of its route)

Inyo National Forest: The increased in use on the John Muir Trail is displayed in figure 34 and applies to the sections of the trail that cross the Inyo National Forest. Additionally, for a short period of a few weeks each year, typically in June, Pacific Crest Trail hikers and equestrians are likely to encounter others as thru-hikers travel north. On the Pacific Crest Trail, through the South Sierra Wilderness, there is currently a low probability of encountering other users on the trail throughout the year. Otherwise, there are no known visitor use management issues within the remainder of the trail corridor associated with thru-hikers.

Recreation Events

Trailwide: Interest in trail running has been increasing in recent years. A study completed by the Outdoor Recreation Participation Report (Outdoor Foundation 2014) noted that 6.8 million Americans ages 6 and older participated in trail running in 2013, which is 2.3 percent of the population. The study concluded that running, including jogging and trail running, was the most popular activity among Americans when measured by number of participants and by number of

[52] See the Yosemite National Park Web site at: http://www.nps.gov/yose/planyourvisit/jmtfaq.htm

total annual outings. Trail running by individuals is allowed on the Pacific Crest Trail without restrictions. Recreation special use permits are required for trail running events that charge fees for participation and/or have more than 75 people participating. By policy, recreation event permits are not allowed in designated wilderness.[53] The concerns regarding commercial competitive events displacing the primary users of the Pacific Crest Trail has been raised through social media in a variety of Web sites. While there is no comprehensive list of events on the Pacific Crest Trail at this time, for the races that that have been compiled, they range in participation from 75 to 800 people per event and total approximately 3,500 people annually.

Inyo National Forest: Ninety-four percent of the Pacific Crest Trail is in designated wilderness and there are no recreation events allowed by policy. Outside of designated wilderness, there are no existing authorizations for competitive events on the trail. Recreation special uses are authorized within the Pacific Crest Trail Corridor in the Reds Meadow Valley, including Reds Meadow Resort and Pack Station, and Agnew Meadows Pack Station.

Scenery

Trailwide: While on National Forest System lands, the Pacific Crest Trail may pass through a variety of management areas, with forestwide direction in place that defines the allowable uses (such as hikers and equestrians) of the trail and the visual resource objectives. Since the trail crosses many national forests, it is important to note that the majority of the forest plans for the national forests the Pacific Crest Trail travels through were developed in the 1980s and are still under the visual resource management standards and have not been amended to reflect the currently used Scenery Management System.

Inyo National Forest: The Pacific Crest Trail offers outstanding scenic vistas and panoramic views along the entire 86 miles managed by the Inyo National Forest. In the South Sierra and Golden Trout Wilderness Areas, travelers on the Pacific Crest Trail enjoy views of the South Fork Kern River drainage and vast meadows located on the Kern Plateau. In the John Muir and Ansel Adams Wilderness Areas, Pacific Crest Trail visitors experience stunning vistas of glaciated landscapes, including sparkling blue lakes with a backdrop of high, rocky peaks on the Sierra Crest.

The current forest plan for the Inyo National Forest provides direction that 96 percent of the Pacific Crest Trail corridor will be managed for preservation of the visual quality, while the remaining 6 percent of the corridor will be managed to retain visual quality.

Vegetation Management and Wildfire

Trailwide: In the last 10 years, wildfire has played a significant role in the accessibility and scenic experience of the Pacific Crest Trail for hikers and equestrians. In the last 50 years, 235,521 acres of the Pacific Crest Trail corridor has burned, of which, almost half occurred in the past 10 years. Vegetation and grazing have been managed to reflect the underlying forestwide and management area direction along the trail.

Inyo National Forest: Vegetation within the Pacific Crest Trail corridor has been affected by disturbances associated with past wildfire and a severe wind event. Vegetation within the trail corridor has also been affected by less frequent wildfires resulting from fire suppression.

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[53] Forest Service Manual 2323.13h

Three wildfires occurred during the past 10 to 50 years that affected the trail corridor. Portions of all these wildfires burned with high severity. Research found that wildfires historically burned every 14 to 18 years with low severity (Caprio, Keifer, and Webster 2006). Fire suppression during the past century has resulted in the absence of such regular fire disturbance, which increased the density of smaller trees in the understory of mature forests, and led to encroachment of conifers into meadows. The increased density of trees creates high fuel loading and elevated hazard for high-severity wildfire, such as seen in the Rainbow Fire of 1992. Conifer growth in meadows poses potential for loss of grassland sites in the future. The meadow encroachment is most notable in the smaller grassland sites along the Pacific Crest Trail near Deer Creek, south of Reds Meadow. These meadows may become forested sites in the next few decades without future fire disturbance.

In November 2011, a severe wind event toppled thousands of trees within the Pacific Crest Trail corridor in areas of the Inyo National Forest. The most severe wind damage occurred in the vicinity of Reds Meadow, within the Middle Fork San Joaquin River watershed. The legacy of this wind damage is high fuel loading and increased wildfire hazard in areas with blowdown.

The current trends in ecological conditions are expected to continue, including elevated fuel loads with risk of high-severity wildfire, loss of meadows with conifer encroachment, and other ecosystem disturbance associated with climate change.

Lands Special Uses

Trailwide: The national increase in demand for renewable energy, especially wind development, has competed with the footpath of this “crest” trail, significantly changing the scenic integrity of the trail at a landscape scale in Kern County, California. Additionally, authorizations for new or larger transmission lines, pipelines, and other utilities have produced changes in the scenic integrity of the trail corridor in all three states the trail passes through. Table 98 and table 99 summarize the number and acres of wind applications and authorizations by the Bureau of Land Management as of March 2015, which are primarily concentrated in the desert and southern areas of the state (Bureau of Land Management 2015). The wind testing authorizations exclude projects submitted for development. For the wind development authorizations, the Bureau of Land Management has authorized more than 3,000 wind turbines on public lands before 2003, but they are not included in this table.

Table 98. Wind renewable energy summary (number) by Bureau of Land Management in California, October 2015

Area	Testing Applications	Testing Authorizations	Development Applications	Development Authorizations
Statewide	15	13	3	3
Desert	15	9	1	3
Central CA	0	1	1	0
Northern CA	0	3	1	0

Table 99. Wind renewable energy summary (acres) by Bureau of Land Management in California, October 2015

Area	Testing Applications	Testing Authorizations	Development Applications	Development Authorizations
Statewide	219,878	93,590	26,009	26,795
Desert	219,878	52,738	6,720	26,795
Central CA	0	0	7,882	0
Northern CA	0	40,852	11,407	0

Table 100 summarizes the number and acres of solar applications and authorizations by the Bureau of Land Management as of October 2015. The Bureau of Land Management has also approved six transmission line rights-of-way associated with private land solar facilities.

Table 100. Solar renewable energy summary by Bureau of Land Management in California, Oct 2015

Area	Development Applications (numbers)	Development Applications (acres)	Development Authorizations (number)	Development Authorizations (acres)
Statewide Acres	5	34,806	8	21,091
Desert Acres	5	34,806	8	21,091
Central CA Acres	0	0	0	0
Northern CA Acres	0	0	0	0

Inyo National Forest There are no authorizations for lands special uses along the Pacific Crest Trail, such as wind turbines, utility transmission lines, or pipelines.

Socio Economic Considerations

Trailwide: The Outdoor Recreation Economy Report (Outdoor Industry Association, Western Governors' Association, and Moto 2012) identifies that outdoor recreation creates 6.1 million American jobs and produced $646 billion in outdoor recreation spending each year and 80 billion in Federal, State, and local tax revenue. The outdoor recreation economy thrives when Americans spend their dollars in the pursuit of outdoor recreation. This spending occurs in two forms: the purchase of gear and vehicles, and dollars spent on trips and travel. It is estimated that for every dollar spent on gear and vehicles, four dollars are spent on trips and travel.

The Pacific Crest Trail resupply points within counties that the forest plan revision covers include the towns of Lone Pine, Independence, Bishop, Mammoth Lakes, Tuolumne Meadows, and Lee Vining and the businesses of Kennedy Meadows General Store, Muir Trail Ranch, Vermillion Valley Resort, and Red’s Meadow Resort. These communities receive an influx of recreation-related supply and service requests as Pacific Crest Trail hikers and equestrians travel through or near their communities. While the economic contribution of Pacific Crest Trail travelers alone has not been studied, California State Parks (BBC Research & Consulting 2011) estimated recreational visitors to California parks and participants in the major recreation activities in California spent over $20 billion on trip expenditures and equipment. Trip expenditures include a variety of goods and services such as overnight lodging, restaurant meals, groceries, and gasoline. The sources of direct recreation expenditures vary considerably among the regions. The Sierra region had the largest direct expenditures ($3.5 billion) associated with visitation to federally managed lands (see the section on economic conditions in the “Recreation and Tourism” section.

Environmental Consequences

The revised forest plan components will provide for management of the Pacific Crest Trail corridor based on the applicable authorities and the nature and purposes of the trail. Uses and management activities are allowed in designated areas to the extent that these uses are in harmony with the purpose for which the area was designated. (FSH 1909.12 24.2). Within designated wilderness, the uses allowed reflect wilderness management direction and legislative requirements. Outside of designated wilderness (MA-PCT), the desired setting is consistent with or complements the semi-primitive nonmotorized recreation opportunity spectrum class which is consistent with the nature and purposes of the Pacific Crest Trail. Uses allowed within the management area include, vegetation management, prescribed burning and fire suppression, grazing, and leasable minerals (no surface occupancy), and utility projects. Use of existing roads and trails that are legally open to motorized and mechanized use may continue. Activities that are prohibited conflict with the desired conditions for the trail and could substantially impact the nature and purposes of the trail. There are 2,455 acres in the Pacific Crest Trail Corridor outside of wilderness which is 0.1 percent of the Inyo National Forest. While there are some changes in use that will occur, there is opportunity outside the management area to provide for other uses.

Recreation Opportunity (MA-PCTW-DC-02 and MA-PCT-DC-03)

Table 101 outlines the recreation opportunity spectrum class within each alternative. The Pacific Crest Trail Comprehensive Management Plan allows for the full range of the recreation opportunity spectrum to be experienced with rural and urban sections of the trail “generally be(ing) as short as necessary to allow passage across or under highways and railroads or passage through developed areas.” No acres of the Pacific Crest Trail are classified as urban in the recreation opportunity spectrum in any alternative.

Consequences Common to All Alternatives

Alternative A provides the least amount of acres in all categories of the recreation opportunity spectrum. Alternative C provides the most acres in the primitive and semi-primitive nonmotorized classes with alternative A providing the least.

Table 101. Acres of each recreation opportunity spectrum class in the Pacific Crest Trail Management Area

Alternative	Primitive	Semi-primitive Nonmotorized	Semi-primitive Motorized	Roaded Natural	Roaded Modified	Rural
Alternative A	112	0	2	2	0	0
Alternative B	37,685	359	0	320	1,610	0
Alternative B-modified	37,685	359	0	320	1,610	0
Alternative C	119,673	3,493	3,196	0	2,471	1,517
Alternative D	20,975	59	0	297	721	0

Table 102 displays the corridor acres by alternative with alternative C having the most number of acres, followed by B, D, and A in all alternatives.

Table 102. Acres of Pacific Crest Trail corridor inside and outside of designated wilderness

Alternative	Inside Wilderness	Outside Wilderness	Total	Percent of Acres in Wilderness
Alternative A	112	4	116	96%
Alternative B	37,519	2,455	39,973	94%
Alternative B-modified	37,519	2,455	39,973	94%
Alternative C	116,507	13,843	130,350	89%
Alternative D	20,900	1,152	22,052	95%

We received letters expressing concerns about the loss of motorized and mechanized (bicycle) opportunities within the Pacific Crest Trail corridor. Table 103 displays the miles of motorized roads and trails within the management area that occur outside of designated wilderness areas. Ninety-four percent of the Pacific Crest Trail on the Inyo National Forest is within designated wilderness where motorized and mechanized use is prohibited and no road construction would be allowed.

Table 103. Miles of motorized roads and trails within the Pacific Crest Trail Corridor (outside wilderness)

Alternative	Miles of System Open Road	Miles of System Motorized Trail
Alternative A	0	0
Alternative B	11.5	0
Alternative B-modified	11.5	0
Alternative C	29.6	2.4
Alternative D	6.7	0

Consequences Common to all Alternatives (MA-PCT-SUIT-04)

Trailwide, the Pacific Crest Trail is open to foot and horse travel and closed to motorized[54] and mechanized travel.[55] The existing prohibitions to motorized and mechanized use on the trail itself would continue. Where the Pacific Crest Trail Corridor is in designated wilderness (MA-PCTW), motorized use year around is prohibited by statute.

Outside of designated wilderness, motorized travel is not suitable within the Pacific Crest Trail Corridor (MA-PCT) year around, except at designated crossings of the trail, on interim routes and designated roads and trails within the corridor. (MA-PCT-SUIT). . Within the Pacific Crest Trail Corridor (MA-PCT), existing roads and trails where motorized and mechanized use is authorized is allowed to continue and is not proposed to change within the plan. No change in travel management in the Corridor is proposed in the Final Plan.

The final revised plan (MA-PCT-DC) has a desired condition for the corridor to be naturally appearing in winter with few to no sights, sounds, and resource impacts from motorized use. Existing authorized over snow travel will continue until site-specific analysis through Subpart C of the Travel Management Rule determines where over-snow motorized use will be authorized in the future.

[54] 36 CFR 261.20

[55] Regional Order 88-4

An indirect effect of limiting motorized and mechanized transport to designated crossings, interim routes, and on designated roads and trails may be decreased opportunities in the future for new motorized and mechanized trails within the corridor.

Consequences Common to Alternatives B, B-modified, C, and D (MA-PCT-STD-03 and MA-PCT-GDL-03)

There are no system roads or trails that are proposed to be closed or a change in management or use on trail related to the Pacific Crest Trail corridor in this forest plan revision. New roads (no existing footprint) are not permitted unless required by law to provide access to private lands or documented as the only prudent and feasible alternative. New motorized and mechanized trails within the Pacific Crest Trail corridor may be authorized in site-specific travel management and would be designed to minimize the visual, sound, and resource impacts to the Pacific Crest Trail.

Visitor Use (MAs-PCTW and PCT)

Consequences Common to all Alternatives

We anticipate visitor use to continue to grow based on the increased interest in the Pacific Crest Trail in the past 3 years and trends seen on the John Muir Trail, which uses the same trail tread as the Pacific Crest Trail on the Inyo and Sierra National Forests. Visitor use would not directly vary by alternative and visitor use management strategies may be used by managers in all alternatives to minimize impacts to the physical trail resource and social setting.

Maintenance of the Pacific Crest Trail (REC-FW-OBJ). Seventy-five percent of the forest designated trail system, including the Pacific Crest Trail, is planned to be maintained to standard within 10 years. The Pacific Crest Trail, as a national scenic trail designated by Congress, is prioritized in terms of maintenance.

Recreation Events (MA-PCT-GDL-02)

Recreation events have a potential to disrupt and displace hikers and equestrians that may be using the same section of the Pacific Crest Trail when the event occurs. Some recreationists see the events in a positive manner and celebrate the activity, free food, and companionship. Others are concerned about the numbers of encounters they make over a short period of time with limited sight distance and passing zones on the trail. There are benefits, both economic and health related, from endurance running and riding that are very positive for individuals and communities.

Consequences Specific to Alternative A

Currently, there are no existing permits for recreation events on the Pacific Crest Trail on the Inyo National Forest.

Consequences Common to Alternatives B, B-modified, C, and D

Recreation events are prohibited in designated wilderness by policy. In alternatives B, B-modified, C, and D, recreation events may be authorized outside of wilderness to cross the Pacific Crest Trail and existing events would be allowed to continue. Additionally, recreation events within the Corridor except on the Pacific Crest Trail itself, may be authorized. Since there are no existing permits for recreation events on the Pacific Crest Trail, there would be no displacement of permittees. The prohibition of new events would decrease the potential for displacement of and conflict with the primary Pacific Crest Trail users, hikers (including individual trail runners) and equestrians. Five miles of the Pacific Crest Trail outside of wilderness would be closed to recreation events. Recreation events could occur on the remaining 587 miles of trails outside of wilderness on the national forest with less than a one percent change in opportunity.

Scenery (MAs-PCTW and PCT and PCT-GDL-01)

Table 104 outlines the acres in different scenic integrity objectives, based on the Scenery Management System (USDA Forest Service 1995b), by alternative in the Pacific Crest Trail Management Area.

Table 104. Acres of scenic integrity objectives within the Pacific Crest Trail Corridor, Inyo National Forest

Alternative	Very High	High	Moderate	Low
Alternative A	111	4	0	0
Alternative B	37,519	2,447	7	0
Alternative B Mod	37,519	2,447	7	0
Alternative C	119,427	10,509	413	0
Alternative D	20,900	1,150	2	0

Consequences Common to Alternatives B, B-modified, C, and D

Within the Pacific Crest Trail Management Areas in all alternatives, 99 percent of the scenic integrity objectives are in the very high or high categories.

Consequences Specific to Alternative A

Alternative A provides the least scenic integrity objective acres within the very high and high categories within the Pacific Crest Trail Management Area.

Consequences Specific to Alternative B and B-modified

Alternative B or B-modified would provide the second greatest number of acres within the Pacific Crest Trail Management area for very high and high scenic integrity by identifying the width for including the visible foreground, which can be up to one-half mile of centerline of the trail.

Consequences Specific to Alternative C

Alternative C would provide the most number of acres in the very high and high categories for scenic integrity for the Pacific Crest Trail. In alternative C, visible foreground of up to one-half mile of centerline of the trail is combined with Scenic Attractiveness A landscapes that represent the iconic views. Alternative C would have the most number of acres of moderate scenic integrity objectives for the Inyo National Forest.

Consequences Specific to Alternative D

Alternative D would provide more acres in the very high and high category within the Pacific Crest Trail Management area than alternative A, but less than alternative B and B-modified, by protecting scenic integrity up to one-quarter mile of centerline of the trail.

Vegetation Management and Fuels Treatment (MA-PCT-Potential Management Approach, DC-02 and MA-PCT-GDL-01)

Vegetation and fuels management have a high potential to alter the landscape and affect scenic resources. Activities typically reduce scenic integrity in the short term because of the associated slash prior to burning, stumps, and landing and road construction. In the long term, treatment activities may maintain or enhance scenic integrity, scenic character stability, and the ability to resist insects, disease, and large-scale wildfire. Consequently, treated areas may appear moderately to highly altered for longer periods of time, depending upon the treatment and mitigation measures implemented.

Consequences Common to all Alternatives

In all alternatives, vegetation management for ecosystem restoration would be allowed in the Pacific Crest Trail corridor to retain the desired condition of a naturally appearing landscape. The corridor is suitable for timber production because timber harvest and related management actions would be designed to be compatible with the Pacific Crest Trail desired conditions and objectives for a naturally appearing landscape surrounding the trail.

New roads would not be allowed to be constructed within the Pacific Crest Trail corridor unless they are required by law to provide access to private lands or documented as the only prudent and feasible alternative (MA-PCT-STD-03). Hauling and skidding along the trail would not be allowed to protect the trail integrity (MA-PCT-STD-04).

Fuel reduction efforts (such as mechanical thinning) may result in short-term decreases in scenic quality due to cut vegetation, slash, and disturbed soils. Planning for scenic elements and adherence to design criteria would minimize short-term impacts and reap long-term benefits, thereby meeting scenic integrity objectives. Fuel reduction activities should result in more resilient forest conditions, which should be better able to resist uncharacteristic wildfires (MA-PCT Potential Management Approach).

Management efforts to control insect infestations and diseases that include removal of infected trees and a distance around them often appear as clearcutting to forest visitors. These impacts can occur in areas of high scenic value (like along scenic routes) and may reduce scenic quality in the short term (MA-PCT Potential Management Approach).

Consequences Common to Alternatives B, B-modified, C, and D (MA-PCT-DC-02 and MA-PCT-GDL-01, Potential Management Approach)

The corridor acres are within the lands suitable for timber production. Management area direction supports vegetation management and fuel treatment to provide for ecosystem restoration and to enhance the trail environment. The short-term effects related to vegetation and fuels management activities may decrease scenic integrity. However, long-term effects should increase scenic integrity and scenic stability by restoring ecosystem functions.

Short-term negative effects to scenic resources would be the greatest under alternative D, which would treat more acres mechanically, with wildfire, and prescribed fire than alternatives A, B, B-modified, or C. The greatest improvement to scenic integrity and scenic stability over the long term would be realized under alternative D as ecosystem functions were restored or maintained.

Lands Special Uses (MA-PCT-SUIT)

Energy corridor rights-of-way, communication sites, and wind towers have a high potential to affect scenic resources for a long duration. Cleared rights-of-way and utility structures contrast and may be incongruent with existing landscapes. Cleared rights-of-way generally contrast highly with the surrounding landscape.

Consequences Common to All Alternatives

Commercial extraction of mineral materials such as sand, gravel, pumice, cinders and other common variety minerals would not be permitted issued. Leasable and locatable mineral exploration and extraction is allowable but must contain a “no surface occupancy” stipulation.

Consequences Common to Alternatives B, B-modified, C, and D

Utility rights-of-way (MA-PCT-STD-02) are to be located using avoidance, on-site mitigation, and off-site mitigation (in that order) and should be sufficient to protect trail values.

Alternative C provides the most scenic protection to the Pacific Crest Trail corridor from utility development, communication sites, wind towers, mineral materials, and surface occupancy for leasable minerals followed by alternatives B, B-modified, and D. Eighty-nine percent of the corridor is within designated wilderness where these types of uses are already unsuitable because of the wilderness designation. Alternatives A and D provides the least scenic protection to the Pacific Crest Trail corridor and the least restrictions to communication sites, energy development, mineral materials permits, and surface occupancy for leasable minerals, communication sites, and wind energy development.

Cumulative Environmental Consequences

The cumulative effects analysis area for the Pacific Crest Trail corridor is all lands the trail travels through in the State of California. This area was selected because of ongoing and proposed activities on neighboring national forests, adjacent State and Bureau of Land Management lands (such as renewable energy development and energy corridor developments), and private lands, where the trail is that the trail traverses connecting to public lands.

Recreation Opportunities and Visitor Use

Across California, population growth is expected to grow at approximately 500,000 people each year and reach 50 million by 2050 (California Department of Finance 2014). Increased demand for outdoor recreation opportunities throughout the state and the need for all types of recreation (both motorized and nonmotorized) to be provided is expected to continue.

Along the full length of the Pacific Crest Trail, including the 1,689 miles of the trail in California, future opportunities for motorized and mechanized trails within wilderness are prohibited by law. Future opportunities for motorized and mechanized trails outside of wilderness and over-snow motorized travel may be allowed within the corridor but would require design features to minimize the impacts to the trail. Project level planning, such as Travel Management – subpart C, will determine where over-snow motorized use is authorized and where crossings over the trail, or within the corridor, would occur. On all lands that the Pacific Crest Trail crosses, included easements across private lands, future opportunities for motorized and mechanized trails will have similar considerations for minimizing the impacts of project proposals on the nature and purposes of the trail.

Increased visitor use on the Pacific Crest Trail, especially where the trail overlaps the John Muir Trail, will likely trigger management actions by national forests and national parks, to protect wilderness resources. Visitor use management actions by Federal land management agencies to limit impacts to the trail's physical resources and social settings are likely to increase as a cumulative effect.

Recreation Events

Trailwide and within California, interest in recreation events for trail running is likely to continue with increases in permit applications for races primarily between Memorial Day and Labor Day. These commercial recreation special use permits are prohibited in designated wilderness and future wilderness designations would also prohibit that activity on approximately 30 percent of the Forest Service trails in California. As demand for these types of events increases, other trails on National Forest System and Bureau of Land Management lands (outside of wilderness), are likely to see more recreation events permitted.

Vegetation Management and Fuels Treatment

While there are no known planned actions for vegetation and fuels treatments within the trail corridor in California, it is likely that outside of designated wilderness, projects will be planned to ensure a naturally appearing and sustainable landscape. The likely vegetation and fuels treatments, within in all alternatives, could result in short term cumulative effects to scenic resources. More of the landscape, in the short term, would appear to be moderately to slightly altered until the longer-term scenic integrity objective is achieved. In the long term, treatment activities may maintain or enhance scenic integrity, scenic character stability, and the ability to resist insects, disease, and large-scale wildfire.

Lands Special Uses

The statewide trend in increased renewable energy and energy corridor developments, especially within the southern Sierra, is likely to further impact the scenic resources of the trail. These developments would result in more permanent landscape modifications with impacts to the scenic integrity of the landscape. With the population growth in the state, the demand for renewable energy is expected to grow, as would the need for additional transmission lines to connect to existing or new energy corridors. Project design to avoid the corridor and mitigation strategies to minimize impacts to the trail are likely to be needed.

Analytical Conclusions

Overall, based on the amount of area identified within the Pacific Crest Trail Management Area, alternative C provides the most protection for the resources, qualities, values, and associated settings and primary uses of the Pacific Crest National Scenic Trail followed by alternative B, B-modified, D, and A.

Tribal Relations and Uses

Background

This section summarizes the current tribal relations program on the Inyo National Forest and the potential environmental consequences to Tribes and tribal resources of implementing the draft forest plans and the alternatives.

The indigenous peoples of the Inyo National Forest have an unbroken union with this place for at least 14,000 years (Moratto 1984, Spier 1978, Jones and Klar 2007). The long-term relationship tribal people have with the landscape differs from that of most members of the public (Zedeño, Austin, and Stoffle 1997). A Tribe's creation stories, indigenous place names, sacred geography of ceremonial and religious sites, hunting-gathering and fishing areas, and valued resources all culminate to form part of the tribal identity and welfare (McAvoy, Shirilla, and Flood 2004a). Changes in any proportion or condition of these closely tied people, places, and resources can result in impacts or improvements in the health of Tribes and the environment. Thus, the rivers, forests, mountains, and meadows we look at on a map or experience on the national forest are intrinsic to the traditions and livelihoods to Tribes, and the Tribes are very concerned about impacts or changes to those areas.

The Federal Government has a trust responsibility to federally recognized American Indians, as well as a public trust for the management of natural, cultural, and heritage resources. As land managers, Forest Service staff know that the areas they currently manage are also ancestral lands to many Tribes, creating the need to have effective relationships with these Tribes. The agency is directed by Federal policy, laws, and associated authorities to engage in formal consultation, and to provide avenues for additional communication and collaboration with federally recognized Tribes. Nearly every action undertaken by the Forest Service has the potential to affect tribal relations and uses either directly or indirectly (Toupal 2003). Effects to tribal relations and uses can be adverse or beneficial, short term or long term. Some effects may be mitigated or avoided either through tribal consultation (such as, knowledge learned regarding potential impacts or consequences of management actions) or redesign (such as, practices that avoid, reduce, or mitigate undesired impacts; Toupal 2003, Burger 2008).

Positive relationships with Tribes are important to maintain. Tribes maintain traditional ecological knowledge and pass it down through generations through oral and, in modern times, written accounts utilizing contemporary technologies and tools. Resources that are important to Tribes need to be reviewed not only individually, but holistically at a landscape level (Zedeño, Austin, and Stoffle 1997, Watson et al. 2011). Tribal communities are interested in consultation, collaboration, and coordination on overall resource condition of the national forest. However, Tribes are also keenly interested in access to the national forest and in vegetation management and watershed function pertaining to ecological goods and services necessary to maintain, enhance, and perpetuate tribal traditions and livelihoods. In managing tribal resources, it is important to consider the ecocultural attributes for associated ecological goods and services and how Tribes may value these resources differently than the public (Burger et al. 2008).

The people of various Tribes rely on different ecosystems across the bioregion that provide natural and cultural resources necessary to perpetuate tribal traditions and livelihoods (Anderson and Moratto 1996, Lake and Long 2014a). This includes gathering from and tending trees such as pinyon pines (Zeanah 2002, Farris 1982) for primary food sources, medicinal plants, basketry and construction materials from plants, the harvesting of fish and game, and culturally important subsistence and spiritual activities (Anderson and Moratto 1996) including cross-Sierra travel and trade trips (Arkush 1994), and sacred ceremonies (Kroeber 1925, Moratto 1984).

Conditions on National Forest System lands that are not currently in line with desired conditions could contribute to limited or denied access to traditional foods, leading to food insecurity and increased mental and physical health problems (Jernigan et al. 2012). This also can increase the loss of intergenerational traditional knowledge and practices among tribal communities (Turner and Turner 2008), which is an international and national issue of concern for indigenous peoples (Pimentel et al. 1997) (Food and Agriculture Organization of the United Nations 2015).

Analysis and Methods

No modeling was used for this analysis, but there are some frameworks and tools that can be applied for considering risk, or the consequences with alternatives regarding the change in condition or effects, on tribally valued resources and cultural practices in response to alternatives (Toupal 2003, Burger 2008, Pollard et al. 2008). This analysis was developed after a series of meetings where Tribes, tribal groups and organizations, traditional cultural practitioners, and other interested individuals consulted and collaborated on the development of the plan (USDA Forest Service 2015d). At these meetings, attendees were able to see draft materials and visit with Forest Service officials, staff officers, and subject matter experts regarding the intent of revising the plans. Input was considered in developing the proposed action, refining the proposed action, and developing alternatives. The analysis uses a qualitative analysis of the following indicators and measures.

Indicators and Measures

For many years the Forest Service has maintained a primary suppression approach to fire management that has led to great success in initial attack and suppression of wildfires (Show and Kotok 1924, Stephens and Ruth 2005). This fire management approach has been in direct conflict with tribal efforts to continue natural and human-induced fire on the landscape to benefit and maintain tribal uses (Lake and Long 2014a). Historic tribal fire use across the landscape provided for the numerous resources that were subsequently encountered by the influx of Europeans (Anderson and Moratto 1996). Ironically, those same newcomers to the Sierra Nevada chastised, and subsequently criminalized, the traditional practices of the Native Americans' use of fires (Timbrook, Johnson, and Earle 1993). Fire suppression has led to excessive fuel loading in ground, surface, ladder, and canopy fuel. This has resulted in large, high-intensity wildfires (Miller, Safford, et al. 2009) with increased fire intensity and severity, some of which has been attributed to recent climate change (Miller and Urban 1999). These higher severity and more extensive fires across the landscape impact natural and cultural resources, tribal values, tribal areas of importance, and sacred sites (Timmons, deBano, and Ryan 2012, Welch 2012). Tribal values and interests are impacted by both uncharacteristic fire and fire deficits (for example, reduction in natural and tribal ignitions). This change in the frequency and extent of fire has contributed to increased forest density and homogeneity and increased fuel loading of ecosystems. This has made forests harder to travel through by the Tribes and has decreased shrub and non-forest.

Tribal access can be affected by policy decisions, administrative actions, and physical impacts on the ground. Specific concerns from resource management activities, including road building or other modifications on the landscape, could affect tribal members accessing valued places (gathering areas or sacred sites) or practicing cultural activities. These specific concerns are best addressed at the site-specific level during project or activity planning. However, designated areas located in the plan area (such as, Wilderness, Wild and Scenic Rivers, and National Scenic and Historic Trails) and recommending additional areas for designation in forest plans might impact the reserved rights and interests of Tribes. Wilderness designations are controversial with the general public as well as with Tribes (Stumpff 2000). Forest Service staff recognizes the importance of working with Tribes on protected areas, such as Wilderness, to create collaborative management strategies that meet mutual interests. The idea of maintaining these areas in their "pristine" condition through a "hands off" approach lacks consideration for traditional ecological knowledge and associated practices conducted by Tribes, tribal groups and organizations, and traditional cultural practitioners (Stumpff 2000, McDonald, McDonald, and McAvoy 2000, Watson et al. 2011). This is especially true when it does not recognize that Tribes have historically managed these landscapes through the introduction of fire at appropriate times of the year and in specific locations (Blackburn and Anderson 1993).

Plants and animals that are traditionally and currently important for cultural uses (for instance, food, fiber-basketry, medicinal, spiritual) are not able to be sustainably utilized at levels desired by Tribes when the ecosystems they occur within are degraded, managed for other conflicting interests or values, or are not accessible to Tribes for traditional cultural purposes. Planning fuels and fire treatments across the landscape typically address bio-physical aspects of fire regimes (Collins and Stephens 2010), but do not commonly incorporate socio-cultural values with the understanding of how tribal communities are dependent upon fire in different ecosystems, habitats, and a range of resources affected by fire in the short-and long-term necessary to perpetuate tribal traditions and cultural practices (Toupal 2003; Anderson and Moratto 1996; Raish, González-Cabán, and Condie 2005; Carver et al. 2009). Traditional knowledge can inform fuels, wildfire, and forest management approaches better suited to address tribal concerns, as well as aid in fulfilling the trust responsibility for the management of natural and cultural resources (Lake and Long 2014a, Mason et al. 2012).

Reduction of Threat of Wildfire to Tribal Resources

Large, high-intensity wildfires damage and destroy resources and sites important to Tribes. The alternatives take different approaches to reduce fire threat across the national forest. The reduction in fire threat is evaluated in the "Fire Management" section.

Amount of Recommended Wilderness that May Limit Access to Areas Important to Tribes or Use of Tribal Resources

Many sites and resources of importance to Tribes are located in remote locations and have been used traditionally for many generations. Designating these areas as wilderness may limit or impair access to these sites or the ability of Tribes to continue to conduct ceremonies and gather resources in traditional ways, including managing the land using traditional practices. The area of recommended wilderness in each alternative is used as a proxy for the potential to impact tribal use of the land and resources.

Number of Sites Restored Specifically for Tribal Resources

The environment surrounding resources of tribal importance was directly or indirectly managed for thousands of years by Tribes. With modern management and the current changed environment, many resources used by Tribes are in diminished quantity and quality and are in need of restoration. The alternatives vary in their approach to improving resources of tribal importance and the number of sites restored for tribal resources will be the metric used as an indicator of impact to tribal uses.

Assumptions

- The potential effects to Tribes and tribal resources is an agency consideration at the outset of any and every project planning process.
- The Inyo National Forest will continue to regularly conduct Government-to-Government meetings to provide opportunities to the tribes to consult on all proposed activities on

National Forest lands. Consultation with tribes is guided by a variety of laws, regulations, executive orders, and policies that provide direction for interacting with tribes on national forest lands. For example, USDA Departmental Regulation 1340-007 (United States Department of Agriculture 2008) provides policy and implementation guidance to implement the 2000 Executive Order 13175 on Consultation and Coordination with Indian Tribal Governments. This guidance is independent from forest plan direction and does not change across alternatives.

- The Inyo National Forest will continue to also include tribal groups and organizations, traditional cultural practitioners (USDA Forest Service 2008), and interested individuals in discussions about tribal relations and uses.
- The tribal relations programs on the Inyo National Forest may need to increase as tribal consultation increases. Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals have expressed an interest in more opportunities to consult and collaborate on proposed activities. This may be a challenge given expected budgets.

Affected Environment

Forests often serve as sources of traditional medicines, food, firewood, and basketry materials for Tribes. Certain areas may also be particularly sacred and valued for their importance in sustaining cultural traditions and beliefs. When implementing the forest plan, the Forest Service may through separate decisions conduct or authorize various types of activities that have a substantial impact on Tribes (Vogel 2001, Toupal 2003, Burger et al. 2008). Those impacts would vary widely depending on the level of collaboration maintained with tribal concerns. These could include grant programs, timber sales, mining, road building, recreational development and use, archaeological excavations, energy development, and other program and project activities (Yablon 2004).

Many cultural resources are both fire- and water-dependent. Basketry materials such as redbud, deer grass, willow, chaparral, and sour berry bush need fire enhancement (Anderson 1999). Mints and various teas and medicines, such as yarrow, thrive on water and are found in wetlands, meadows, and water drainages, but still need fire to maintain their health and usability (Anderson and Moratto 1996). Without an occasional burn these resources would become less abundant, have increase diseases or pests, and develop morphological characteristics unsuitable for traditional uses. Similarly, without fire, meadows, creek banks, and river and lake shores become overgrown with stronger, bigger vegetation (like willows, alders, and conifers that require more water from the water table). Pine nuts (pines) are the least ground-water-dependent food sources, but they must be able to absorb precipitation. Without a good rainfall, or with too much, overhead canopy develops and pine nuts will either not grow or they will not produce at the levels desired by Tribes. Fire helps to reduce the canopy, and the amount of duff on the ground, which can become breeding grounds for insects that destroy the pine nut crops (California Department of Water Resources 2014).

Environmental Consequences to Tribal Relations and Uses

Consideration of Climate Change in Alternatives

Climate change and associated disturbances (for example, drought, fire, insect outbreaks) have in the past (North, Van de Water et al. 2009), are now, and will likely continue to (Lenihan et al.

2003, Moritz and Stephens 2008) affect tribally valued resources (Voggesser et al. 2013, Chief et al. 2014). Several climate change-related risk and modeling assessments have been completed that include the geographic scope of the plan area (Sierra Nevada Alliance 2010).

Current and projected changes in forest and water resources affecting tribal communities are considered in the analysis of the alternatives (see the “Terrestrial Ecosystems” and “Aquatic and Riparian Ecosystems” sections). Vulnerability of valued natural resources, tribal coping, and adaptive strategies can be informed by tribal consultations (traditional ecological knowledge) and available assessments specific to Tribes (Alexander et al. 2011). Incorporating strategies and actions from climate vulnerability assessments and risk assessments for species and forest resources may need to be broadened to mitigate the potential impacts of climate change on tribal communities at a scale beyond the influence of the forest plan (Burger 2008, Burger et al. 2008). For example, the use of strategic vegetation restoration may reduce the spread of wildfires, and reduce threats to communities, but have little influence on drought and vegetation response in more remote areas where tribal activities occur. Similarly, focusing on increasing water availability for domestic uses in dams and reservoirs may not address the need for improving water supply in seeps and springs that have been traditionally used by Tribes. Assessments and planning tools generally are not specifically applicable to Tribes, as Tribes are only identified as other “stakeholders” (Sierra Nevada Alliance 2010). Other Federal and State agency approaches have used tribal consultation frameworks to solicit and incorporate tribal traditional ecological knowledge in to climate-related assessments (California Natural Resource Agency 2014).

Consequences Common to all Alternatives

All alternatives retain and continue with existing tribal consultation, sacred site, and non-timber forest products mandates and agreements. Forest plan direction for resource management, such as heritage, vegetation, soils, water, riparian, aquatic, and wildlife, for all alternatives is designed to provide for protection of cultural resource sites or traditional cultural properties.

All alternatives would provide for habitat and watershed conditions that would greatly contribute to the persistence of species at sustainable and harvestable levels. Invasive species would be managed to avoid encroachments on culturally significant foods, fiber/material, and medicinal resources. Also, resource conditions would be monitored.

Researchers have worked with Tribes in other regions to identify and address approaches for mapping tribal landscape values related to fuels and fire management that can benefit Tribes by enhancing access to and the quality of resources (Carver et al. 2009, Lake 2013). Fire can be targeted at specific locations, forest types, or habitats to promote a range of tribally valued resources. For example, in riparian areas where a decreased water supply has degraded vegetation, fire can be used to emulate flooding disturbance to enhance willows for basketry materials and wildlife habitats. Fire can also be used in different seasons for different objects or to align both public and tribal objectives, such as reducing hazardous fuels around communities and enhancing access to desired forests and resources (Carver et al. 2009, Lake 2013). This increased consideration of the approach and timing of restoring fire to the landscape would occur in all alternatives.

Management activities (such as mechanical thinning, prescribed burning, managing wildfires to meet resource objectives, and recreation) implemented to avoid or mitigate adverse effects to heritage and cultural resources and tribal values (Carver et al. 2009) may afford greater protection from large, high intensity wildfires compared to consequences from continued forest growth and increasing forest density (Miller and Urban 1999, Miller, Knapp, et al. 2009). Activities associated with wildfire suppression under emergency conditions can inadvertently have adverse impacts to heritage and cultural resources (Welch 2012). For example, during fire suppression activities, a dozer line may inadvertently run through sites and areas important to Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals. Burnout or back burning may also adversely affect sites. Establishing water bars on firelines and leaving vegetation cover to prevent erosion during mop-up and burn area emergency response could reduce access and mobility of tribal practitioners who use the fireline which may be along a former historic Indian trail along ridge systems (Lake 2011, Welch 2012). However, it is standard practice to use resource advisors during wildfires to help identify cultural resources and mitigate or avoid these impacts. Additionally, national forest personnel may consider developing fire management agreements with Tribes that allow tribal representatives and heritage consultants to be officially designated within the incident management team for wildfires (Lake 2011).

Consequences Common to Alternatives B, B-modified, C, and D

The emphasis on variable treatment intensities and on vegetation heterogeneity in alternatives B, B-modified, C, and D should provide additional opportunities for Tribes to consult, collaborate, and actively participate in planning processes, as well as identify potential mechanisms for how they can be involved with the implementation of landscape restoration treatments (for instance, Tribal Forest Protection Act and along boundaries of Federal and tribal lands).

The revised forest plan would include the desired condition that "the need for tribal access to traditional sites is acknowledged and supported." While the Tribes need access to traditional areas and sites, there are some sacred sites where American Indians conduct ceremonies that require privacy and solitude and are free from auditory or visual distractions and obstructions. Building roads to or near such sites may lead to increased visitation by the public or Forest Service staff that could affect ceremonies and undermine cultural practices. Roads or resource management activities may alter the character and diminish the value of historic or cultural places. However, consultation would occur to identify concerns and adjust management so that adequate access for agency management or public use does not compromise cultural practices at traditional, cultural, and spiritual places.

The forest plan includes a possible management approach which recognizes that the Inyo National Forest could increase its capacity to improve tribal relations by considering employee exchange opportunities carried out under "Service First" or other mechanisms. Providing opportunities for tribal relations staff to temporarily exchange jobs would provide a better reciprocal understanding of programs and promote better utilization of tribal programs and legislation that would mutually benefit the national forest and Tribe. This approach is similar to interagency details, and could extend to inter-governmental details for work assignments between Tribes and the Forest Service, or at higher regional or national scales with agreements between the Bureau of Indian Affairs for Tribes and the Forest Service.

Consequences Specific to Alternative A

Alternative A represents the continuing direction from the existing plans (as amended). The forest plan revision process has provided Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals additional information regarding the planning process in general. Tribes have expressed an interest in not doing business as usual. While the government-to-government meeting process improves communication and is used in alternative A, Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals may have fewer opportunities to be involved in the management process and to maintain or improve tribal values. Alternative A does not have tribal interests and values integrated explicitly into plan components as much as the other alternatives.

Reduction of Threat of Wildfire to Tribal Resources

Alternative A reduces fuels to try to reduce the impacts of large, high-severity wildfires that can affect tribal resources and values, but at a pace and scale where large fires are still likely to occur.

Amount of Recommended Wilderness that May Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternative A would not add new areas recommended for addition to the National Wilderness Preservation System and would not contribute to the potential for reduced access. Alternative A would not add additional constraints on tribal access to gather, use resources, or hold ceremonies in these areas.

Number of Sites Restored Specifically for Tribal Resources

Under alternative A, the Inyo opportunistically develops or designs projects specifically to improve or maintain resources of tribal importance. Very few if any improvements are made specifically to benefit resources of importance to Tribes.

Consequences Specific to Alternatives B and B-modified

Alternative B is the draft forest plan that carries forward existing direction still relevant and not in need of change and also addresses those identified needs for change based on comments received during the scoping process and input from tribal forums hosted by the Inyo National Forest. It includes integration of tribal interests and values in desired conditions for other resources and a plan objective to restore areas of tribal interest.

Reduction of Threat of Wildfire to Tribal Resources

The proposed increase in pace and scale of ecological restoration under alternative B could improve ecological sustainability and benefit tribal interests and values when projects incorporate traditional ecological knowledge, support active involvement (such as, Government-to-Government consultation and coordination), and foster traditional management practices (Carver et al. 2009). For example, areas that are important for basketry materials or traditional food sources would benefit from hazardous fuels treatments that reduce surface and ladder fuels, or tree density that foster access and mobility, as well as increase the observation and locating of valued resources. This alternative considers opportunities for managing wildfires to meet resource objectives that can be informed by the tribal consultation process and collaborative fire planning. For example, national forest heritage program staff consult and communicate with Tribal historic preservation officers and tribal leadership about identifying landscape values at risk, and under what conditions fire should be suppressed or managed for ecological and cultural resource objectives. See details for “Wildland Fire Decision Support System” (Noonan-Wright et al. 2011), and for “Heritage/Tribal Values” (United States Department of the Interior 2010; Timmons, deBano, and Ryan 2012, Welch 2012).

An increase in pace and scale that incorporates traditional ecological knowledge (Lake and Long 2014a) could provide opportunities to Tribes to develop tribal economies (Carver et al. 2009). In general, ecological sustainability benefits tribal interests, and can foster access to and support uses of habitats and resources for traditional cultural purposes. See sections on ecological sustainability of terrestrial, aquatic, and riparian ecosystems for more detail. Most, if not all, of traditional tribal management and uses were and are compatible with modern principles of ecological sustainability. Ecological restoration projects that incorporate tribal place-based knowledge would provide Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals with opportunities to protect, restore, and preserve traditional gathering areas, ceremonial areas, and sacred sites (Watson et al. 2009).

Amount of Recommended Wilderness that Might Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternative B would add new areas recommended for addition to the National Wilderness Preservation System on the Inyo National Forest. While many tribal activities would be allowed and could still occur within areas recommended for wilderness, it is the access to these sites that may be affected. No motorized routes would be affected but some activities such as gathering and ceremonial uses may be restricted or more difficult if areas are managed as wilderness.

Number of Sites Restored Specifically for Tribal Resources

The Inyo National Forest includes a plan objective to implement 1 to 5 restoration or maintenance actions to enhance resource availability for traditional tribal collection activities per decade. These projects would be determined in consultation with the Tribes and integrated with other restoration projects where possible. While these activities could occur under alternative A, they are more likely to occur under alternative B because of the specific plan objective.

In addition to areas improved specifically for tribal resources, alternative B includes desired conditions for tribal relations and uses that encourage the coordination with Tribes to recognize traditional ecological knowledge in managing resources. This encourages silviculture and fuels managers to design mechanical treatments to restore tribally valued trees or use areas while simultaneously achieving other restoration needs. Ecological restoration of springs and meadows would consider those that are important for many tribal uses, including meadows and water sources along cross-Sierra traditional travel routes (Arkush 1993, Chartkoff 2001). Reintroducing fire that increases ecological sustainability is beneficial to Tribes when designed to avoid using diesel and gasoline, such as drip torch fuel mix, where basketry and food plants are gathered, as well as considering appropriate seasons and frequencies of burning.

Consequences Specific to Alternative C

Alternative C places an emphasis on providing more short-term protections for wildlife habitat by reducing the amount of mechanical thinning and emphasizing more use of fire to restore ecosystems. This alternative proposes recommending more acres of wilderness than other alternatives.

Reduction of Threat of Wildfire to Tribal Resources

Alternative C treats the least amount of area to restore vegetation and reduce the risk of large, high-intensity wildfires using mechanical treatments. Alternative C is designed to achieve a reduction in the risk of large wildfires through thinning only smaller trees and using prescribed burning. Areas with prescribed burning could benefit resources of tribal interest by restoring fire to the ecosystem. This alternative has the most area untreated of all the alternatives and the risk of large, high-intensity wildfires is the highest compared to the other plan revision alternatives, leaving many resources of tribal interest at high risk.

Amount of Recommended Wilderness that May Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternative C would add the largest number of new areas recommended for addition to the National Wilderness Preservation System. While many tribal activities would be allowed and could still occur within areas recommended for wilderness, it is the access to these sites that may be affected. No motorized routes would be affected but some activities such as gathering and ceremonial uses may be restricted or more difficult if areas are managed as wilderness.

The western approach toward the adoption of wilderness has been found to be controversial in the Native American communities (Watson et al. 2011). Tribal leaders and traditional cultural practitioners are concerned that access to sacred places, traditional gathering areas, and tribal resources would be impacted with additional wilderness designation. Most of the tribal opinions are opposed to the addition of wilderness areas because, historically, the tribal communities had access to their entire ancestral territory and actively managed those lands now titled as wilderness through the use of fire for cultural subsistence, ceremonial, and livelihood objectives at the appropriate times and places (Anderson and Moratto 1996). Wilderness designation can hinder access to, and severely limit desired tribal practices in tribal cultural properties (Parker and King 1998) as well as traditional gathering areas, and may limit or potentially prevent some traditional practices from occurring (Zedeño, Austin, and Stoffle 1997). Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals also commented that additional restrictions that wilderness status and regulations impose may include the number of people who gather at a site for religious purposes may be limited and infringe upon tribal rights. Conversely, some Tribes believe that designating areas as wilderness may afford those locations with what Tribes would consider as “last resort” significant protections that could prevent over access and damage to sacred sites (TRIB-FW-DC-02). Management plans for wilderness areas would include tribal perspectives (TRIB-FW-DC-01) and attempt to incorporate traditional ecological knowledge (TRIB-FW-DC-04) and associated traditional practices (TRIB-FW-DC-03) to maintain the integrity of the area similar to “pristine pre-contact” conditions based upon desired conditions and goals (TRIB-FW-GOAL-01 and 04) that are common to the alternatives B, C, and D.

Number of Sites Restored Specifically for Tribal Resources

Alternative C would have the same number of sites restored specifically to benefit tribal resources as alternative B. However, more of the restoration would be accomplished with prescribed burning and with hand treatments and limited mechanical thinning to remove only small-diameter trees due to restrictions on tree removal for other wildlife species.

Consequences Specific to Alternative D

Alternative D is the most aggressive in terms of emphasizing an increased pace and scale of ecological restoration. Whenever there is an increase in development, such as the increase in recreation opportunities afforded under this alternative, or an increase in the scale of treatments, there is potential for increased direct and inadvertent effects to tribal resources, traditional cultural properties, and sacred sites. This is especially true given the small amount of lands on the Forest that has been inventoried for heritage resources (see “Heritage Resources” section).

Reduction of Threat of Wildfire to Tribal Resources

Alternative D reduces the threat of wildfire to tribal resources the most of all alternatives because the most strategic areas along roads and ridges would be treated. This presents a higher potential for inadvertent impacts to tribal resources in the short term, but with greater long-term benefits by restoring tribal uses areas across the landscape.

Amount of Recommended Wilderness that May Limit Access to Areas Important to Tribes or Use of Tribal Resources

Similar to alternative A, there are no additional areas recommended for wilderness in alternative D. Areas that are currently accessible and used by Tribes would continue to be accessible.

Number of Sites Restored Specifically for Tribal Resources

The number of sites restored specifically for tribal resources would be the same as alternative B. There would be more area restored indirectly due to the larger treated area where vegetation desired conditions could also favor improvement of conditions for resources of value to Tribes such as pinyon pine, willow, and meadows.

Cumulative Effects

Tribes, tribal groups and organizations, and traditional cultural practitioners depend on the land and resources that cross multiple jurisdictions and ecosystems. Much of the lands in the analysis area is managed by Federal land management agencies which all have requirements for Government-to-Government meetings with Tribes to consult and coordinate management of the land and resources to meet tribal and agency responsibilities. Land and resource management under the revised forest plan is generally consistent with management across the Federal agencies regarding tribal relations and uses. The increased emphasis on restoring fire to the landscape in all alternatives would complement the increased restoration of fire within adjacent national parks. This would result in increased resilience of sites and resources important to Tribes across a mixed-jurisdictional landscape.

Analytical Conclusion

All alternatives would continue the important Government-to-Government meetings for activities that may affect Tribes. Alternatives B, B-modified, C, and D include additional plan direction that improves the integration of tribal interests into restoration project planning. These alternatives would provide for increased opportunity to improve access to and use of resources important to Tribes, tribal groups and organizations, and traditional cultural practitioners.

All of the alternatives could have some level of effect on tribal heritage resources given that less than one-fifth of the plan area has been systematically inventoried for heritage resources and that most known recorded sites remain unevaluated for their qualifications for inclusion in the National Register of Historic Places. However, to meeting the increased pace and scale of restoration treatments, a variety of management practices to ensure compliance with section 106 of the National Historic Preservation Act would be required. This includes pre-project surveys for heritage resources and tribal consultation and collaborative risk planning between Forest Service heritage and cultural resource staff, Tribal Historic Preservation Officers, and involved tribal practitioners, to predict where particular valued resources or potential sacred sites may occur in anticipated treatment areas (Timmons, deBano, and Ryan 2012; Welch 2012). A project-level planning process before implementation of activities may reduce the impacts of increased restoration activities.

Reduction of Threat of Wildfire to Tribal Resources

The amount of active vegetation management that might reduce threats from large, high-intensity wildfires to sites and resources of tribal importance increases the most in alternative D, followed by alternatives B and B-modified. It would remain the same as current levels in alternative A and could decrease in alternative C resulting in an incremental loss of sites or diminished access to resources used by Tribes over time. The use of prescribed burning would reduce risks from future wildfire and would improve conditions for many resources of interest to Tribes. All alternatives would address minimizing impacts to Tribes at specific locations during project planning, and alternatives B, B-modified, C, and D include specific plan direction to incorporate opportunities to improve sites and resources important to Tribes during project planning.

Amount of Recommended Wilderness that May Limit Access to Areas Important to Tribes or Use of Tribal Resources

Alternatives A and D would have the least impact to access to sites and resources by Tribes, tribal groups and organizations, and traditional cultural practitioners since no new areas would be recommended for wilderness designation. Alternative C would have the most potential impact with the most proposed wilderness because access to and use of areas may create additional barriers for tribal members. The ability to conduct ceremonies and to gather resources could be impaired or limited in areas managed to maintain their wilderness characteristics. For example, ground-disturbing activities associated with tribal use of these areas may be limited or perceived to be unacceptable by the public. Alternatives B and B-modified include some areas recommended for wilderness designation on the Inyo National Forest. Access to and use of resources in these areas would be similar to those described for alternative C, though to a smaller degree.

Number of Sites Restored Specifically for Tribal Resources

Alternatives B, B-modified, C, and D include a plan objective that provides Tribes, tribal groups and organizations, traditional cultural practitioners, and interested individuals with opportunities to protect and restore sacred sites and resources used traditionally by Tribes, and to provide opportunities for consultation, engagement, collaboration, and tribal economic benefits and values. In addition to those specific restoration projects, alternative D would provide more opportunities to restore other sites and resources than alternative B by having more landscape restoration treatments. Alternative D would also require more coordination to protect tribal sites and resources due to the increased amounts of mechanical treatments. Alternative C provides fewer additional opportunities to restore tribal resources because mechanical treatments are more limited and instead relies more heavily on prescribed burning.

Forest Benefits to People and Communities

Forest Products and Management

This section focuses on the subject of providing forest products and summarizes the current environment on the Inyo National Forests in terms of estimated available forest product quantities by alternative and the resources (both commercial and noncommercial) associated with harvest of those forest products. This analysis, along with the sustained yield limit and the projected wood sale program can be found in "Appendix A: Timber Suitability and Management."

The desired conditions for forest products and management are:

> Wood products are generated on a sustainable basis and contribute to ecological, social and economic sustainability, and associated desired conditions by helping to maintain and improve local industry infrastructure sufficient to meet the needs of ecological restoration over the next several decades. A sustainable mix of forest products is offered under a variety of methods in response to market demand and restoration needs.
>
> Salvage of dead and dying trees captures as much of the economic value of the wood as possible while retaining key features in quantities that provide for wildlife habitat, soil productivity, and ecosystem functions.

Further analysis related to forest products and management may also be found in the "Terrestrial Vegetation" section and "Appendix A: Timber Suitability and Management."

Background

Prior to the early 1990s, Inyo National Forest management of the Jeffrey pine forest north and east of Mammoth Lakes, California emphasized production of commercial wood products, such as sawlogs and fuelwood. Using an even-aged silvicultural system, the Inyo harvested 7 to 10 million board feet of wood products annually. The majority of these wood product volumes were sawlogs from old, large-diameter Jeffrey pine trees.

In the early 1990s, a new policy initiative was announced for management of all national forests. Forest managers were directed to take a more holistic approach to natural resource management. Generally, national forests, including the Inyo, began to deemphasize commercial wood products and began promoting retention and development of old growth or pre-European settlement forest conditions. Even-aged silvicultural systems were abandoned and replaced with an uneven-aged silvicultural system, where thinning of younger stands and retention of older, larger Jeffrey pine trees became standard practice. Commercial wood products, while still important, became a by-product rather than the driving force of this new management strategy.

Before European settlement of the eastern Sierra region, wildland fire was a frequent and integral natural process in the Jeffrey pine forest ecosystem. Low-intensity surface fires regularly burned under and through the Jeffrey pine forest and similar forest throughout California, scorching or consuming duff, needles, grasses, shrubs, and smaller trees. Evidence of these low-intensity surface fires can be seen locally on fire-scarred Jeffrey pine trees and stumps. This scarring suggests fire return intervals were variable, but usually between 5 and 20 years.

In the early 20th century, a series of large and deadly wildland fires occurred in the Lake States and northern Rocky Mountains. As a result, the Forest Service and other land management agencies were directed to suppress and control all wildland fires, with little regard for the role fire may have played in the ecosystem. In Jeffrey pine forests of the eastern Sierra, regular fire scarring of trees and stumps abruptly ends by the 1920s, as natural fire all but disappeared from the landscape due to highly successful suppression efforts. As a result, both surface and aerial fuels increased, as dead material accumulated on the forest floor and young trees began to grow and fill in available space. The Sierra Nevada has suffered frequent high-intensity wildfires since the 1970s, especially during the drought years of the 1980s and 1990s and in the past 4 drought years. Increasing fuel loads, higher summer temperatures, and prolonged droughts have combined to allow fires to burn at higher severity over larger areas than was common under the presettlement fire regime.

With the advent of ecosystem management in the early 1990s, the Inyo began to recognize the important role fire historically played in reducing fuels and maintaining a healthy Jeffrey pine forest ecosystem. A program of regular spring and fall prescribed burning was begun, to slowly reintroduce low-intensity surface fire to the Jeffrey pine forest. To date, over 16,000 acres of Jeffrey pine forest in the Mammoth Lakes-June Lake area have benefited from use of low to high-intensity prescribed fire.

More recently, several regional and national initiatives and environmental analyses have provided management direction consistent with, and supportive of, management direction adopted by the Inyo for the Jeffrey pine forest since the early 1990s. The Sierra Nevada Forest Plan Amendment and its associated Final Supplemental Environmental Impact Statement and Record of Decision amended land management plans for all Sierra Nevada national forests to promote overall forest health and reduce risk of loss from large-scale wildland fires and insect and disease outbreaks.

The 2001 National Fire Plan, 2002 Healthy Forest Initiative, and 2003 Healthy Forest Restoration Act all have provided additional direction on managing forest ecosystems to reduce risk of catastrophic wildland fire and generally improve forest health and resilience. National forests were directed to reduce unnatural fuel accumulations through mechanical treatment and prescribed fire, using pre-European settlement conditions as a guide for managing forest structure, species composition and density, and reintroduction of fire to ecosystems. Special emphasis and priority was placed on the Wildland-Urban Intermix for fuels reduction and forest health efforts, so as to better protect homes and communities from wildland fire. Management direction found in these documents closely paralleled the Inyo’s efforts since the early 1990s.

Current levels of tree mortality, linked to the collective effects of insects, pathogens, and a warming climate—all exacerbated by 4 years of below-average precipitation—appear likely to affect future yields of forest products. While projected harvests are well below annual growth rates, the sudden loss of living conifers and the beginning of mortality effects on the eastside, may result in reduced yields in areas where mortality is high.

Analysis and Methods

Analysis Area

While the analysis area consists of all National Forest System lands within the Inyo National Forest, the primary focus includes lands identified as suitable for timber production.

Lands Suitable for Timber Production

Lands identified as suitable for timber production include forested lands not administratively withdrawn that have a reasonable assurance of regeneration, and where forest management is consistent with other multiple-use management objectives. The Inyo National Forest includes approximately 70,608 to 85,025 acres that are suitable for timber production, depending on alternative. See appendix A for more detailed methodology on the determination of suitable lands. Timber suitability is a part of the plan revision process, that while the Inyo National Forest does not currently sell commercial sawlog products (mainly due to prohibitive haul costs), we are performing this analysis to identify potential options for the planning period.

Lands Not Suited for Timber Production

Timber harvest may be used as a tool for purposes other than timber production to enhance other multiple use values. Forest product removal from lands not suited for timber production is most common in response to salvage, hazard-tree removal or other safety concern, scenic vista enhancement, fuel reduction, wildlife habitat improvement, or access, among other reasons. In addition, timber harvest on lands not suitable for timber production may respond to restoration objectives such as conifer encroachment in meadows, aspen enhancement, or hardwood restoration. In these cases, timber harvest would be used as a tool to achieve the desired conditions, but is not part of the programed regeneration harvest plan for lands deemed suitable for timber production. As forest product removal from these lands is more responsive than proactive, these lands are not the focus of this analysis and will not be discussed further in this section.

Temporal Scale

The analysis period consists of two decades (20 years). Although the National Forest Management Act provides that forest plans are to be revised at least every 15 years, it limits the sale of timber to less than the sustained yield limit for each decade of the plan (16 U.S.C. 1611). Providing estimates of the annual projected wood sale quantity and the annual projected timber sale quantity, for each of first two decades, aligns with the National Forest Management Act decadal periods limiting the sale of timber, and provides an estimate for the second decade, if revision of the plan is delayed beyond the 15-year period.

Indicators and Measures

- Amount of forest products removed is a measure of volume. Generally, sawtimber is measured in hundred cubic feet (CCF) or million board feet; fuelwood volume is generally measured in cords or CCFs. (*Note:* Volume calculations were determined utilizing the Forest Vegetation Simulator (Dixon 2002) to model Forest Inventory and Analysis data by vegetation type and prescription class.)
- Area restored to improve forest health and resilience to disturbance is measured in acres. (*Note:* Area treated is a function of available area and workforce capability to treat these acreages.)

Assumptions

- “Area restored” refers to areas that are treated and a commercial timber product and/or fuelwood removed. On the Inyo National Forest, all products currently are sold as fuelwood under either commercial fuelwood contracts or personal use permits. Nothing is currently being sold as commercial sawtimber. An area where prescribed burning only or other service work is performed, is not a measure under the forest products indicator.
- It is assumed that commercial forest product opportunities (beyond fuelwood and other specialty wood markets) on the Inyo National Forest will continue to be limited due to the haul distance to existing mills.

- It is assumed that opportunities to utilize biomass will remain the same for the first decade of the analysis period, but could increase in the second decade if a demonstrated consistent supply of biomass leads to new facilities or utilization opportunities.
- It is assumed the contract authorities for forest product removal will continue to include stewardship contracts (both integrated resource service contracts and integrated resource timber contracts), and stewardship agreements.

Affected Environment

The Inyo National Forest's forested lands consist primarily of dry mixed conifer, Jeffrey pine, red fir, and lodgepole pine stands. Approximately 1.9 million acres are withdrawn from timber production due to administrative designations (such as National Wilderness Preservation System, inventoried roadless areas, research natural areas, and other designated areas (appendix A)) and lands classified as nonforested lands or lands where adequate stocking is not assured. Of the remaining forested area that is not withdrawn, a total of 70,608 to 85,025 acres, depending on the alternative considered, have a reasonable assurance of successful conifer regeneration and are on lands with management objectives consistent with timber harvest being a primary or secondary multiple use objective. These lands are identified as suitable for timber production. See appendix A for more information regarding timber suitability determinations for each alternative. Table 105 displays the percentage of area in major California wildlife habitat relationship (CWHR) types for alternatives B and B-modified. Table 106 displays the percentage of area in the regional dominance types for alternatives B and B-modified.

Table 105. Percentage of cover type (California wildlife habitat relationship) of lands suitable for timber production for alternatives B and B-modified

Cover Type	Percent
Eastside Pine	77
Lodgepole Pine	13
Sierra Mixed Conifer	6
Red Fir	2
White Fir	1
Jeffrey Pine	1

Table 106. Percentage of cover type (Regional Dominance Type) of lands suitable for timber production for alternatives B and B-modified

Cover Type	Percent
Eastside Pine	77
Lodgepole Pine	13
Mixed Conifer - Fir	6
Red Fir	2
White Fir	1
Jeffrey Pine	1

The Terra Bella mill is the last remaining sawmill in California south of Yosemite National Park. While this Sierra Forest Products mill in Terra Bella as well as mills in Sonora and Chinese Camp are the closest mills to the Inyo National Forest, these mills have long haul distances and narrow roads that typically make transportation prohibitive.

Maintenance of local forest products infrastructure is key to sustainable restoration goals. Not only does timber harvest contribute to the economy in an ecologically sustainable way, it is a tool used to improve forest health by reducing densities in a precise manner, unlike disturbance agents, such as, insects, pathogens, and wildfire and the other management tools of prescribed fire. Timber harvest can identify specific trees to remove or retain and can manipulate the distribution of fuels to influence the effects of prescribed burning or wildfire on residual trees and other desired resources, such as particular nest or denning trees or snags used by wildlife. As with all actions, timber harvest is designed to achieve desired conditions, taking into account other appropriate management objectives such as riparian habitat conservation, habitat management, and scenic stability.

On National Forest System lands, trees too small for use as sawtimber can often be removed and utilized as biomass, providing enhanced forest management capabilities. Projects that are able to efficiently remove both forest products and biomass products are capable of meeting a broad set of management objectives. A dependable supply of valuable forest products enhances the likelihood that infrastructure would be available to meet these needs.

Forest Products

The term “forest products” generally refers to sawtimber, but for the Inyo National Forest, firewood or fuelwood is the main product sold. Many forest users including Tribes, residents, and recreationists participate in firewood collection. This has averaged approximately 4,400 cords per year (data derived from Region 5 Cut and Sold Reports, 2010–2014; USDA Forest Service 2016).

Special Forest Products

The Inyo National Forest is also a source for a variety of special forest products. Special forest products are generally collected in small quantities for personal use, or larger amounts for commercial purposes, and are often authorized through a permit system. These products may include bark, berries, boughs, bulbs, Christmas trees, cones, ferns, mushrooms and other fungi, mosses, nuts, roots, seeds, transplants, and wildflowers. Forest users, including Tribes, depend on many of these special forest products for their medicinal properties, decorative uses, native propagations, landscaping, family or tribal tradition, or for ceremonial purposes.

Area Restored

Many decades of fire suppression have resulted in overcrowded, dense forests, vulnerable to disease and insect infestation, uncharacteristic wildfire, and the effects of a warming climate. Many management methods (including timber harvest, prescribed fire, mastication, hand piling, and burning) can and would be used to restore the landscape to a more resilient condition. The most common treatment is thinning, which improves forest health and resilience and can often move treated areas more directly toward desired conditions. Group selection is used to promote regeneration of shade-intolerant species (specifically, pine), by creating small openings that are large enough that seedlings that need sunlight can grow. Group selection also restores seral stage heterogeneity that has been lost due to the ingrowth of shade-tolerant species and the reduction in thinning that would have occurred by wildfires because of fire suppression. When available, revenue generated from timber removal may be reinvested into other more expensive restoration treatments.

Environmental Consequences

Consequences Common to all Alternatives

Special Forest Products

Utilization of special forest products and personal-use fuelwood is generally anticipated to remain consistent with current conditions into the future, with minimal increases due to population trends. It is also anticipated to be relatively consistent across all alternatives. While alternative C includes additional acres recommended for wilderness designation, this is not anticipated to play a significant role in special forest product and fuelwood availability considering the scale of remaining forested areas available for collection and the typical remoteness of these areas. There could be some consequences for tribal gathering in alternative C, which we have described in more detail in the "Tribal Relations and Uses" section. Special forest product and fuelwood removal is tied more closely with demand than locational availability. In other words, people would travel to obtain these products. As demand is not anticipated to change across alternatives, special forest products and personal-use fuelwood will not be addressed further in relation to any alternative.

Forest Products

All alternatives assume some level of forest product removal. Table 107 displays ranges in volumes projected to be removed. The Inyo National Forest has projected sawtimber harvests that are a very small fraction of the estimated sustained yield. If considering the projected maximum sawtimber levels associated with alternatives B and B-modified, the percent of the sustained yield is 4 percent for the national forest.

Table 107. Projected 10-year timber harvest volumes (million cubic feet) by product type and alternative

Product	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Sawtimber	1	1–1.5	1-1.5	<1	1.5–3
Fuelwood	6–8	6–9.5	6-9.5	4–7	9.5–14

While the harvest of sawtimber is not estimated for mortality related to high-intensity fire, droughts, and other unplanned disturbances, it can have an effect on a projected decadal harvest schedule. Initially, this mortality may displace the projected harvest of living trees. It would be expected that the quantities would range from very low with alternative C to approximately equal amounts in the remaining alternatives. In the longer term, the loss of living forests after significant disturbance events, in effect, can erase significant acreages of growing forests and reduce the total capacity of a national forest to maintain a specified harvest level.

When the number of acres affected reaches a threshold value, the capability of any specific national forest to maintain the projected yields will decline. The ability to minimize or reverse this impact is dependent on the successful reestablishment of thriving forests. Without that happening, the total available sawtimber volume that would ordinarily be able to offer projected harvests, would decline and start a trend that, in essence, reduces the total acreage available and suitable for timber production.

Projected sawtimber harvests are displayed in table 107 as a range of values. The minimum value in alternatives A, B and B-modified is the current condition based upon a 5-year average, the minimum for alternative D is estimated to be the maximum for alternatives B and B-modified due to greater flexibility in achieving desired conditions and encouragement of larger, landscape-level projects, while the minimum range for alternative C is one-quarter the current condition due to limitations on tree removal. The maximum value in the range is the amount of sawlog volume available for removal, when consistent with management objectives, and would be part of a contract or project that is economically viable. This maximum value is based on Forest Vegetation Simulator modeling of likely prescriptions associated with each alternative using Forest Inventory and Analysis plot data across the analysis area and assumes an increased agency workforce with increased funding over the current condition because of the increased effort needed for project design, analysis, and implementation over more treatment areas.

As stated above, fuelwood demand is expected to remain consistent with current conditions or increase slightly due to population trends. Fuelwood varies slightly on the Inyo National Forest because much of the fuelwood gathering opportunity is associated with piles of logs left after mechanical thinning and commercial fuelwood gathering that would vary by restrictions associated with the alternatives.

Due to the long distance between the Inyo National Forest and existing mill facilities, the vast majority of local processing of forest products is for fuelwood. Milling of timber resources for products other than fuelwood is currently minimal and limited to a few local individuals who manufacture items such as posts and poles, rough siding, arts and crafts, furniture, and other products. As such, current and projected sawtimber opportunities on the Inyo National Forest are projected to remain at the current level for the foreseeable future.

Area Restored

All alternatives include silvicultural practices designed to contribute to the restoration of a more resilient landscape. Acres projected for treatment over the next decade are displayed in table 108 as a range. The minimum value for alternatives A, B, and D is projected to approximate the current level of harvest; the maximum value is the total estimated number of acres associated with the harvest volumes estimated in table 107. Alternative C is anticipated to provide forest products over a reduced acreage due to existing and additional constraints on removal of sawlog-size trees, as well as differing treatment prioritization that emphasize the use of prescribed burning instead of tree cutting and restoring areas using wildfires that can be managed to meet resource objectives.

Table 108. Projected 10-year harvest area in acres by management practice and alternative

National Forest	Management Practice	Alternative A	Alternative B	Alternative B-modified	Alternative C	Alternative D
Inyo	Thinning	8,000	8,000–11,500	8,000–11,500	2,300–4,500	11,500–16,000
Inyo	Group Selection	1,000	1,000–2,000	1,000–2,000	0	2,000–4,000

It is important to note that the treated acres in table 108 refer to areas harvested with the removal of a timber product, which is a subset of the projected total of mechanically treated acres of each alternative. Treated areas would be managed primarily with variable density thinning which is an approach that selectively removes trees to increase spatial and structural variation, while retaining selected elements or biological legacies (large/old trees, snags, and logs) in a desired arrangement (such as aggregated in clumps, dispersed in a uniform pattern). Thinning reduces stand density and improves overall stand health, as individual trees have increased access to available resources such as water, sunlight, and nutrients. These additional resources result in accelerated growth and canopy development, while improving the likelihood that individual trees survive, when confronted with insects and pathogens, drought, and low- to moderate-intensity wildfire (Latham and Tappeiner 2002). Group selection openings would generally be small areas between 0.5 to 3 acres where most or all trees are removed to facilitate the establishment of a new age cohort. Group selection when used in combination with variable density thinning, generally mimics historic disturbance processes by regenerating approximately 15 percent of the forested stand, increasing heterogeneity across the landscape and contributing early seral regeneration patches, within an overall uneven-aged landscape (Franklin et al. 2002; North et al. 2012; North, Stine, O'Hara et al. 2009). In addition to providing valuable forest products for society, the precision of these treatments increases the likelihood that associated restoration goals are achieved. Fire, even if used intentionally, does not allow that level of specificity for tree arrangement, size, and species distribution.

Treatment Costs

Table 109 presents a 10-year estimate of the total costs of mechanical treatment, prescribed fire and managed fire activities across the plan revision alternatives. Each of these restoration activities is used at a different rate under each of the plan revision alternatives and as a result, the total costs of these alternatives vary. These results show that alternatives B, B-modified, and D have the higher estimated total costs and alternative C has lower total costs. It is important to note that this analysis is only looking at costs and not the effectiveness of restoration activities. Therefore, a lower cost alternative is not necessarily the best option as it may not yield the best restoration outcomes.

Table 109. Ten-year discounted cost estimates for mechanical, prescribed fire and managed fire activities in each plan revision alternative

Alternative B-modified	Alternative B	Alternative C	Alternative D
$9.2 million	$9.2 million	$6.3 million	$13.8 million

Consequences Specific to Alternative A

Alternative A maintains the current level of activity, using existing management direction as provided by the 2004 Sierra Nevada Forest Plan Amendment Record of Decision (USDA Forest Service 2004b). Alternative A assumes future funding and project design consistent with current levels. Generally, less than 5 to 10 percent of the landscape has been restored in the last 10 years.

Forest Products

Based on historic averages, alternative A would produce approximately 1 million cubic feet of sawtimber, with an additional 3 million cubic feet in other products (miscellaneous convertible products such as posts and poles), and 6 to 8 million cubic feet in fuelwood over a 10-year period (see table 107 and appendix A, table A-3).

Implementation projects are generally designed to thin relatively small-diameter sawtimber trees, reducing fuel adjacent to communities at risk of loss or damage from uncharacteristic wildfire. There are some biomass removal opportunities in conjunction with sawtimber removal, but the lack of a consistent market combined with pricing structure challenges results in most biomass opportunities going unutilized. Most biomass that cannot be economically sold and removed from the forest is piled and burned to reduce fuel and meet the project objectives. Revenue generated from individual projects could be utilized to offset the costs of other restoration activities that require additional funding to implement, such as watershed or habitat improvements. This alternative produces more revenue than alternative C, but less than alternatives B, B-modified and D.

Area Restored

Alternative A, based on historic averages, would harvest timber from approximately 9,000 acres per decade across the Inyo National Forest (see table 108 and appendix A, table A-4). In addition to ecological restoration needs, treatments are prioritized based on proximity to the wildland-urban intermix. The majority of treatments would be in the montane ecological zone, with minor amounts in the upper montane ecological zone. Forest types in the montane zone include dry mixed conifer and montane hardwood-conifer, while the upper montane zone includes red fir, Jeffrey pine and lodgepole pine.

Based on historic averages, projects are generally designed to treat approximately 1,000 acres across a 5,000 acre area, or approximately 20 percent of a small landscape (generally a subwatershed). At the stand level, these acres have an improved likelihood of resilience to the effects of insects and pathogens, climate change, and wildfire. This scale of treatment may result in less uncharacteristic wildfire activity at the local project scale, but by itself is not sufficient to alter the increasing trend in large wildfires expected with climate change (see “Fire Trends” section). In addition, many standards and guidelines limit tree density reduction, potentially leading to increased inter-tree competition for scarce resources and increased tree mortality. Related to thinning and improving the sustainability of forest products, this alternative restores more acres than alternative C, but less than alternatives B, B-modified, and D.

Consequences Specific to Alternatives B and B-modified

Alternatives B and B-modified incorporate four strategic fire management zones: community wildfire protection; general wildfire protection; wildfire restoration; and wildfire maintenance zones. Approximately half of the lands suitable for timber production are located in the two “protection” zones. Alternatives B and B-modified prioritize fuel reduction and restoration treatment in the two protection zones as well as on strategic ridges and along key roads that can facilitate larger landscape prescribed burns or that can increase the opportunity to manage wildfires when they can meet resource objectives. At least 20 percent of the landscape is anticipated to be restored through various management activities, including timber harvest.

Forest Products

Based on stand modeling combined with projected capabilities, alternatives B and B-modified would produce approximately 1 to 1.5 million cubic feet of sawtimber and 6 to 9 million cubic feet in fuelwood over a 10-year period (see table 107 and appendix A, table A-3). This alternative is expected to produce more revenue than alternatives A and C, but less than alternative D.

Revenue generated from implementation of individual projects could be used to offset costs of other restoration activities that may otherwise remain unfunded. With an increase in area treated, more biomass removal opportunities, in conjunction with sawtimber removal, are available, provided a consistent market could utilize these opportunities. Larger, landscape-scale ecological restoration projects (such as whole watersheds) are encouraged under alternatives B and B-modified. If designed in ways to increase economic efficiencies, increased revenues may be generated per project. Through stewardship contracting, or trust funds, this revenue could be used to restore additional or more costly areas than under alternative A.

Area Restored

Alternatives B and B-modified would harvest timber from approximately 9,000 to 13,500 acres per decade across the Inyo National Forest based on projected national forest capabilities (see table 108 and appendix A, table A-4). Treatments are prioritized based on strategic fire management zone, with an emphasis on treating within the two wildfire protection zones. However, treatments are not limited to the protection zones. Vegetation types treated in alternatives B and B-modified would be comparable to those treated in alternative A.

Alternatives B and B-modified encourage larger landscape-scale projects, with the intent that greater areas would by analyzed and more area restored. Fewer limitations on tree removal compared to alternative A would increase the likelihood that thinning of dense stands would be more biologically effective at achieving resilient conditions and would result in more sustainable forest stands over increased acres. At the stand level, these acres would increase the likelihood of resilience to the effects of insects, pathogens, climate change, and wildfire, and would come closer than alternatives A and C, but would not quite be sufficient to alter the increasing trend in large wildfires expected with climate change (see “Fire Trends” section). This scale of treatment would result in less uncharacteristic wildfire activity at the project or landscape scale. This alternative restores more acres than alternatives A and C, but less than alternative D.

Consequences Specific to Alternative C

Alternative C focuses on emphasizing short-term protections for wildlife habitat, and relies more on standards and guidelines to minimize localized effects of active management on species such as listed amphibians, and other species of conservation concern. Commercial timber sales are generally limited to small-diameter sawtimber removal, with maintenance of greater stand densities and higher canopy cover. Treatments similar to alternative A could occur in portions of the wildland-urban intermix defense zone. However, it is anticipated that prescriptive constraints such as diameter limits would reduce the area treated to one half or less of current levels.

Forest Products

Based on modeling and projected national forest capability, alternative C would produce less than 1 million cubic feet of sawtimber, with an additional 4 to 7 million cubic feet in fuelwood over a 10-year period (see table 107 and appendix A, table A-3). This alternative generates the least amount of forest products, and associated revenue, of all the alternatives analyzed in detail.

The implementation of alternative C is likely to produce limited revenue, as lower-value product removals, such as small-diameter sawtimber, in generally smaller-scale projects, restrict the efficiencies more common with projects designed in other alternatives. Smaller projects, combined with smaller-diameter removal, contribute to more costly harvest operations that would likely need to be supplemented with appropriated dollars to accomplish objectives. Since budgets are expected to remain similar to those of the last 5 years, appropriated funds would offset the costs of fuel reduction on fewer acres overall.

Area Restored

Alternative C anticipates timber harvest from approximately 2,300 to 4,500 acres per decade across the Inyo National Forest (see table 108 appendix A, table A-4). Thinning treatments focus on small- to medium-sized trees and are focused primarily in the wildland-urban intermix defense zone immediately surrounding communities. Prescribed fires and wildfires managed to meet resource objectives are the preferred methods of restoration treatment, thereby substantially reducing product output or timber harvest opportunities.

Alternative C encourages less intensive treatments, meant to minimize impacts to existing habitat in the short term. At the stand level, these acres would improve the likelihood of resilience to the effects of insects and disease, climate change, and wildfire. However, these effects would be to a much lesser degree than alternatives A, B, B-modified and D, due to the minor density reductions associated with only small-diameter tree removal. Minor reductions in inter-tree competition are not likely to provide sufficient increased access to growing space and the related site resources and any benefits are very short term because of continued growth of trees. Limited increases in tree vigor, combined with the limited acreages affected by treatment, are unlikely to provide a significant improvement in the status of forest health. Retention of high stand densities would continue to contribute to mortality, thus increasing fuel levels and contributing to stand conditions trending away from overall desired landscape conditions.

While wildfire risk would be reduced in the short term at the stand level within the treated areas, the low levels of accompanying mechanical thinning that would assist the effectiveness and efficiency of prescribed fire or wildfire managed to meet resource objectives may actually limit fire use. This scale of treatment may result in less uncharacteristic wildfire activity at the local project scale, but would not be sufficient to alter the increasing trend in large wildfires across the landscape expected to occur due to climate change and other stressors. Under alternative C, almost all funding for vegetation treatments would have to come from congressionally appropriated funds or from partnership dollars because there is little opportunity for stewardship or trust fund support, both of which depend on the sale of commercial forest products to generate funds. This alternative mechanically restores the least amount of acres of all the alternatives analyzed in detail.

Consequences Specific to Alternative D

Alternative D includes an emphasis on an increased pace and scale of ecological restoration, including improving the resilience of forests to fire, drought, climate change, insects, and pathogens. It emphasizes long-term habitat conservation by making areas more resilient to stressors, recognizing there may be short-term impacts to habitat associated with active management. Treatments focus on effective density reductions, lengthening the time that treatments are effective before growth increases stand density to levels outside the natural range of variation. More strategic treatments in the restoration zone would occur than under alternative B or modified alternative B. By conducting more mechanical treatments in the areas that are easy to treat with mechanical equipment, alternative D would create landscape conditions that would allow for greater use of fire (both prescribed fire and management of wildfires to meet resource objectives) in areas that are difficult to treat with mechanical equipment. This would lessen the risks from large, high-intensity wildfires to other forest stands. During thinning, increased numbers of medium and large trees would be removed to favor the development and vigor status of even larger trees. Up to 60 percent of the treated landscape is anticipated to be restored through various activities including timber harvest.

Forest Products

Based on modeling and projected capability, alternative D would produce approximately 1.5 to 3 million cubic feet of sawtimber and 9.5 to 14 million cubic feet in fuelwood over a 10-year period (see table 107, and appendix A, table A-3). This alternative produces the most revenue of any alternative analyzed in detail.

Revenue generated from implementation of individual projects could be utilized to offset costs of other restoration activities that may otherwise remain unfunded. Provided the existence of biomass utilization infrastructure exists, increased biomass removal, often linked with sawlog harvests, would increase. Larger, landscape-scale projects (such as whole watersheds) are encouraged under alternatives D, B and modified alternative B, resulting in more revenue generated per project due to increased efficiencies associated with logging costs. Through stewardship contracting, or trust funds, this revenue could be utilized to treat additional or more costly areas than under alternatives A and C. For example, funds generated by the sale of forest products could be applied to road maintenance, small fuels mastication, prescribed burning, habitat enhancements, and aquatic organism passage projects.

Area Restored

Alternative D is anticipated to harvest timber from approximately 13,500 to 20,000 acres per decade across the Inyo National Forest (see table 108, and appendix A, table A-4). While treatments in the two wildfire protection zones are of higher priority, treatment may occur in all strategic fire management zones. The majority of treatments would be in the montane ecological zone, with minor amounts in the upper montane ecological zone. The montane zone consists primarily of dry mixed conifer and montane hardwood-conifer, while the upper montane zone consists of red fir, Jeffrey pine, and lodgepole pine.

Alternative D encourages larger landscape-scale projects, with the intent that greater areas would by analyzed and more area restored. Decreased tree density and increased heterogeneity at the landscape and stand level would improve the likelihood of resilience to the effects of insects and pathogens, drought, climate change, and wildfire in montane and upper montane forests, due to increased adaptive capacity. In addition, wildfire risk would be reduced over time (see "Terrestrial Vegetation" and "Fire Trends" sections). This scale of treatment would result in less uncharacteristic wildfire activity at the project and landscape scale, extending beyond the treated areas. Of all alternatives analyzed in detail, this alternative restores the most acres and results in more resilient forested stands consistent with desired conditions.

Cumulative Environmental Consequences

There are no private timber producing lands in proximity to the Forest. Timber harvest activities on adjacent National Forest System land would not be a factor as the Inyo is separated by designated wilderness from both the Sierra and Sequoia National Forests, and the Toiyabe National Forest (Intermountain Region) has limited timber harvest opportunities.

Alternatives B, B-modified, and D project an increase in area treated and volume removed as the pace and scale of restoration expands. These alternatives would produce enough forest products to maintain the local specialty markets. Maintenance of existing local markets is important to community economic health, as well as ensuring future opportunities for restoration implementation. However, in the absence of sawmill infrastructure, existing capacity issues may limit achievement of the desired objectives in alternative D.

New markets such as biomass facilities may further increase the pace and scale of restoration, especially under alternatives B, B-modified and D. New markets allow for competition, potentially resulting in increased revenue. There are currently no local biomass facilities within communities located within the Forest.

While alternative D projects the greatest annual volume removal, no alternative prescribes harvest at levels nearing the sustainable yield limit (see “Appendix A: Timber Suitability and Management”). This means there is more opportunity to increase pace and scale of restoration given increased fiscal and personnel capacity without jeopardizing the long-term sustainability of the forest and forest productivity.

Alternatives B, B-modified and D use a variety of restoration tools, such as mechanical fuel reduction treatments, timber harvest, hand treatments, and prescribed fire, to achieve desired conditions. Under these alternatives, it is expected that substantial portions of large landscapes may be restored in the next 10 to 15 years. In addition to improved forest health, growth, and resilience to disturbance agents, treating more area (especially reducing densities in montane and upper montane forest stands) increases the likelihood that large landscape areas can withstand the adverse effects of many of the fires experienced in recent years, maintaining much of their forest structure and composition. These forests may continue to provide habitat as well as future multiple-use timber harvest opportunities into the future, without a substantial loss in social, ecological, and economic value.

Alternatives A and C are both likely to result in lower levels of restoration treatments intended to achieve desired conditions than either alternative B, B-modified or alternative D. The increased emphasis in alternative C, to utilize fire, may be more limited than intended, due to the low levels of accompanying mechanical thinning that would assist the effectiveness of prescribed fires or wildfire managed to meet resource objectives. As the trend of elevated wildfire intensities continues to increase under these alternatives, losses of forest structure to wildfire adversely impacts habitat availability, aquatic health, recreation opportunities, and future economic and multiple-use opportunities associated with timber harvest.

Analytical Conclusions

Alternative A would continue management at current levels of mechanical treatments, with limited improvements in forest health and resilience to disturbance agents and climate change at the project (stand) level. Landscape resilience would continue to decline.

Alternative B and modified alternative B could potentially increase pace and scale of mechanical treatments from the existing conditions, incrementally improving forest health and resilience to disturbance agents and climate change.

Alternative C would decrease the pace and scale of mechanical treatments from the existing conditions; however, small improvements in forest health and resilience would occur in the short term at the project (stand) level, similar to alternative A.

Alternative D would increase pace and scale of mechanical treatments from the existing conditions, improving forest health and resilience to disturbance agents and climate change. However, the absence of infrastructure may limit achievement of desired objectives.

Production Livestock Grazing

This section addresses commercial livestock production on forest rangelands and summarizes the current environment on the Inyo National Forest in terms of existing permitted livestock, grazable forestlands and rangelands, and likely trends. Livestock production and rangeland management includes those lands suitable and not suitable for livestock production from previous decisions. The beneficial and adverse effects of production livestock grazing are described throughout this document and a summary of those effects is included in this section. A list of current grazing allotments and their status is described in Appendix D: Range Management; a map illustration is also found in Volume 3: Maps. Range suitability analysis under the 2012 planning rule is not required and previous grazing suitability determinations have not changed. The desired conditions for grazable rangelands and management are:

- Rangelands, along with grazable forestlands and woodlands, provide large areas of contiguous space supporting native vegetation that has the potential to be grazed. These grazable landscapes sustain biological diversity and ecosystem integrity and help to preserve the rural landscape and cultural heritage of the central, southern and eastern Sierra Nevada.
- Forage, browse, and cover meet the needs of wildlife and authorized livestock are managed in balance with available forage. Areas that are grazed have or are trending toward having satisfactory soil conditions, functional hydrology and biotic integrity.
- Domestic livestock grazing maintains the desired rangeland vegetation types represented by diverse plant functional groups, species richness and diversity, and structure and condition of plant communities.

Background

Grazing History

A literature summary on the history of livestock grazing by Allen-Diaz et al. (1999) states that by most accounts, the Gold Rush did not lead immediately to widespread grazing in the Sierra Nevada. However, droughts, floods, and over-supply of cattle and sheep that followed in the 1860’s caused ranchers to drive their stock into the foothills (in (Allen-Diaz et al. 1999). Competition for level crop lands gradually limited ranching to the foothills and Sierra thereafter (Burcham 1982). One author asserts that livestock began to be driven into the Sierra in 1864 in response to devastating drought, and that before that time forage in the Central Valley area was sufficient (in (Allen-Diaz et al. 1999). The Inyo National Forest was established by presidential proclamation in 1907. Prior to establishment of national forests in the Sierra Nevada, grazing of these public lands was an example of open access resources, where no clear ownership is established or enforced (in (Allen-Diaz et al. 1999).

Allen-Diaz et al. reports (1999) that it is sometimes argued overstocking on federal lands was stimulated during both World Wars (Menke 1996). Further, a historian of the national forest, Bill Rowley, asserts that while widespread overstocking occurred in response to WWI, the Forest Service successfully argued against a similar increase in WWII (Rowley 1985).

As noted in the introduction, historic Euro-American uses on the Inyo National Forest were more focused on livestock grazing and mineral prospecting than on timber and recreation opportunities. Regulated livestock grazing has occurred on rangelands of the Inyo National Forest since the national forest was established and continues to be one of a variety of multiple uses on the Inyo. As reported by Menke et al. (1996) in the “Sierra Nevada Ecosystem Project” (SNEP 1996), an aggressive grazing adjustment program began on the Inyo National Forest in 1944, and that by 1950, animal unit months (AUMs) had been reduced by over 40 percent (Vol II, Appendix 50.1, p. 1,311).

Menke et al. (1996) also reported that in the Eastern Sierra region during the post-World War II era (1946-1970) many local livestock operations became smaller and most sheep operations were converted to cattle. Concern about depleted rangeland conditions led to closure of marginal allotments or conversion of sheep allotments to cattle allotments and a reduction in permitted use. Beginning in the 1980s management concentrated on resource protection. The Federal Land Policy and Management Act of 1976, Public Rangelands Improvement Act of 1978, and other environmental laws ushered in a change in management of public rangelands. From 1970 into the 1990s, many allotments were split into small units in order to make them more economical and facilitate management. Stocking rates and seasons of use were reduced; significantly in some cases. In the 1988, Inyo Final Environmental Impact Statement for the Forest Plan states, “In most areas, range condition is poor to fair by Region 5 standards, the trend is static to improving. Meadows and riparian areas are considered poor but improving in terms of range production.” It was also noted that these condition ratings would be higher if based on Great Basin vegetation types used by the Intermountain Region of the Forest Service. A summary of rangeland conditions in the Sierra Nevada Ecosystem Project Report (SNEP 1996), plant species composition on meadows of the Sierra Nevada had improved when comparing transects from 1956-1965 to 1986-1995, including on the Inyo National Forest. Though resource problems persisted in 1999 on montane meadows and uplands there had been remarkable recovery over that forty year period. The report concluded that rangeland management direction to improve ecological functionality and agricultural productivity had not been realized to the full extent possible.

Recent forest plan revisions (USDA Forest Service 1995a, 2001b, 2004c) have focused on vegetation inventories and monitoring with an ecological approach to livestock grazing and management. Conservation and restoration of aquatic, riparian and meadow ecosystems and associated species has had been a primary focus of the Sierra Nevada Forest Plan Amendments (USDA Forest Service 2001, 2004). On the Inyo National Forest many of those changes to the 1988 forest plan, focusing on rangeland conservation and restoration, had already been put into place during Inyo Forest Plan Amendment 6 – Forestwide Range Utilization Standards (USDA Forest Service 1995a). Following the 2001, 2004 Sierra Nevada Forest Plan Amendment, additional effort has been made on the Inyo to inventory and assess special aquatic features, such as fens and springs, aspen communities, willow fly-catcher habitats, and noxious weed infestations. Further adjustments were also made to the grazing browse standards for aspen and willows. Since 2002, the Inyo has participated in conservation measures for the bi-state greater sage-grouse. The Inyo National Forest Sage-grouse Interim Management Policy has been in place since 2012 incorporating livestock grazing guideline requirements into existing grazing permits.

Potential Grazing Effects to Rangeland Ecosystems

Since the 1980s numerous studies have documented the adverse effects and disturbance that livestock grazing activities can have on riparian and uplands. Livestock tend to congregate during warm weather season in riparian areas. Therefore, disturbance from livestock to riparian areas is often disproportionately greater than disturbance to adjoining uplands (Skovlin 1984, Kauffman and Krueger 1984, Fleischner 1994, Magilligan and McDowell 1997). Some concluded, following an extensive review of the literature, that livestock grazing has no documented beneficial ecological effects on riparian areas and at best non-significant negative effects; that livestock grazing is not sustainable (Belsky, Matzke, and Uselman 1999). Belsky et al. (1999) cautions about others (Clary and Webster 1989, Elmore and Kauffman 1994, Burton and Kozel 1996, Weller 1996) who describe the benefits of reduced cattle stocking rates and newer, more intensive grazing systems to improving streamside and riparian conditions. Belsky et al. (1999) is critical of these publications that contrast newer grazing systems to more traditional and destructive grazing systems, such as season-long grazing with high stocking rates not to cessation of grazing and total rest.

Livestock grazing and associated management activities has both direct and indirect physical disturbance effects of varying degrees to landscapes and associated terrestrial and aquatic habitats. These potential disturbances include changes to watershed hydrologic process, primarily infiltration and secondary effects on peak flows, erosion, contaminant transport, and water quality degradation, removal of vegetation by herbivory, changes in plant communities, changes in wildfire frequency and intensity, reductions in ground cover and potential exposed soils leading to wind and water erosion, changes to soil structure and bulk density resulting in compaction or loose soils from livestock trailing and hoof trampling, loose and exposed soils from stream bank, and sod or plant root shearing, lowered water tables.

Repeated grazing in key forage areas can stress individual desirable forage plants leading to diminished root reserves, reductions in plant vigor and shifts in composition of plant communities. Conversion from deep rooted perennial graminoids to annual species is possible when grazing is coupled with other environmental stressors or change agents such as wildfire or drought.

Effects of livestock disturbance to terrestrial wildlife include displacement from resting, foraging and breeding habitats, and water sources, trampling of individuals or ground nests, exposure to disease and parasites. Effects of livestock herbivory to terrestrial wildlife species include reductions in vertical hiding and nesting cover, competition for forage resources, concentrated urine and dung defecation in wildlife foraging and resting areas, vector introduction of invasive plant species such as cheatgrass, and dewatering of meadow and riparian habitats.

Within the plan area livestock grazing is identified as a potential primary stressor to seven animal species of conservation concern including four birds (willow flycatcher, bi-state sage-grouse, Mount Pinos sooty grouse, and great gray owl) and three butterflies (Apache fritillary, Mono Lake checkerspot and Sierra sulphur). Domestic sheep have been removed from five sheep allotments affecting two other species, Sierra Nevada bighorn and Nelson bighorn. See the terrestrial wildlife section for a description of those effects. Effects of livestock herbivory to plant species of conservation concern include uprooting and removal or defoliation of individual plants, interrupted flowering and/or seed dispersal, trampling, concentrated urine and dung defecation on individual plants, increased bare ground and vector introduction of invasive plant species (e.g., cheatgrass). Within the plan area livestock grazing is identified as a potential primary stressor for seventy-four plant species of conservation concern. See the “At-Risk Plants” section for a description of those effects.

Effects of livestock disturbance to aquatic species include accelerated erosion and soil deposition into streams and lakes, hindered trout fry emergence in gravels and decreased winter survival by filling in channel pore spaces, loss of over-hanging streambanks, poor bank stability, reductions in shading and increased water temperatures from riparian tree and shrub browsing; shallower and wider stream channels, replacement of deep-rooted plant species with shallow-rooted plant species and lowered streambank stability. Within the plan area livestock grazing is identified as a potential primary stressor for five aquatic species of conservation concern including one fish species (California golden trout,) and three invertebrates (western pearl shell, Owen’s Valley spring snail, Wong’s spring snail). Two other federally listed trout species (Lahontan cutthroat and Paiute cutthroat) and three amphibian species (Yosemite toad, Sierra Nevada yellow-legged frog, and Mountain yellow-legged frog) that either have had terms and conditions in place for grazing or are outside of any allotments. See the aquatic species section for a description of those effects.

A review and summary of grazing effects to ecosystems in the Sierra Nevada was prepared in the Sierra Nevada Ecosystem Project Report to Congress (Millar 1996). At the request of the Forest Service, that large body of work was given a critical review by the University of California Rangeland Science Team, and summarized and reported back to the Forest Service (Allen-Diaz et al. 1999). These sources of information provided an assessment of the current science base for addressing rangeland issues in the Sierra Nevada; prior to development of the 2001 Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement and 2004 Final Supplemental Environmental Impact Statement (USDA Forest Service 2001, 2004). The Allen-Diaz report, where noted, “grazing” is most often treated as a yes or no proposition, but it really is a complex process where timing, frequency, duration, season of use, and intensity matter. The terms “grazing” and “overgrazing” are not defined in most of the statements where they are used.

In many studies it is also difficult to determine when “historic grazing” is being discussed versus “current grazing.” Without detailed descriptions of grazing season, frequency, intensity, and system as well as a quantitative description of the range site, riparian type, or stream class it is difficult to interpret the work with regard to current livestock management in the Sierra Nevada. Unfortunately, this problem permeates much of the existing rangeland literature.

(Tate 2005) reviewed others and reiterates that Allen-Diaz et al.’s (1999) review illustrates the lack of tested, real world solutions in the literature, and the real need for new approaches to study and define sustainable riparian grazing. Tate (2005) reported findings from a survey of grazing management and corresponding riparian health on 300 stream reaches across California. They were able to correlate site-specific grazing management practices to riparian health; that common grazing practices (such as herding, off site watering) that move livestock away from riparian areas are positively associated with improved riparian and stream health. Tate (2005) concluded that sustainable riparian grazing is dependent upon: 1) working directly with grazing managers to identify grazing practices which maintain riparian health yet are logistically and economically feasible; and conducting research at the ranch and grazing allotment scale to insure the results are relevant at the management scale.

Current Grazing

There are 50 livestock allotments administered by the Inyo National Forest. Thirty-six of the allotments are active; 11 are vacant and 3 are closed. Refer to appendix D for an illustration and summary table of current allotments. In 2016, 4,540 head of cattle, 54 head of horses and 13,320 head of sheep were permitted to graze at various times throughout the year on the Inyo, with the primary grazing season between June 15 and September 30. A total of 29,710 animal unit months (AUMs) were authorized to graze under a term grazing permit on National Forest System lands (USDA Forest Service 2013a). By contract the Inyo had 56 active allotments in 1984 for a total of 38,194 animal unit months (USDA Forest Service 1988b); an overall decline of 22 percent in permitted animal unit months in the last 28 years. Permitted use has remained stable over the last 10 years as reported in the Grazing Statistical Report from 2006 to 2016 shown in figure 35.

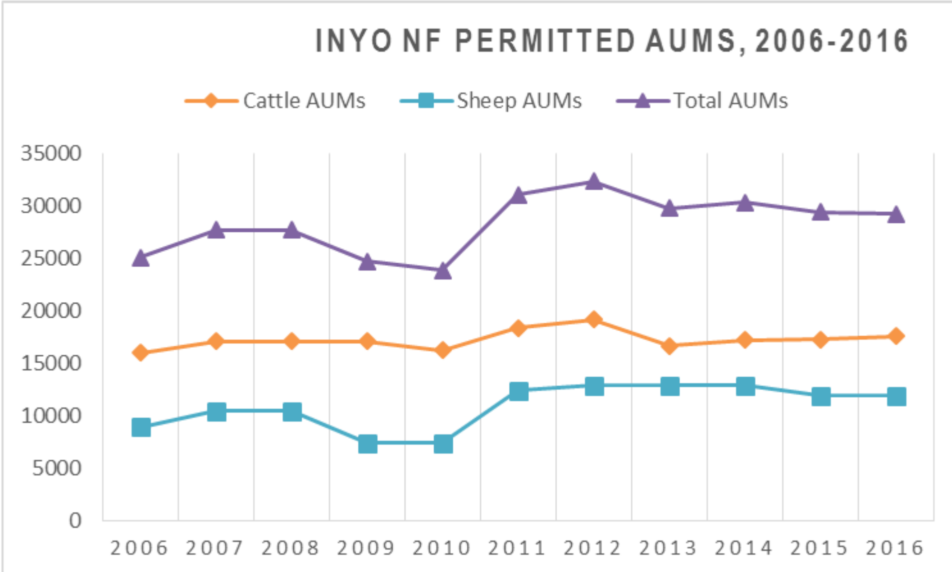

Figure 35. Inyo National Forest animal unit months (AUMs) from 2006 through 2016
(Source: Forest Service Natural Resource Manager (NRM) website, Annual Grazing Statistical Report: Detail at national forest Level)

Forty of 47 or 85 percent of active and vacant allotments have had environmental analysis and an allotment management decision made since passage of the Rescissions Act[56] of 1995, which addresses grazing permit issuance and a required scheduling of allotment analysis in compliance with the National Environmental Policy Act (NEPA). Twenty-two allotments are scheduled for environmental analysis or reanalysis within the next decade (2017-2028) as described in the National Allotment NEPA Schedule (USDA Forest Service 2017d). Some of these projects include possible reactivation of vacant allotments and/or converting former domestic sheep allotments to cattle allotments.

Livestock permittees who use National Forest System lands on the Inyo National Forest contribute to the local economy in Inyo and Mono Counties. In addition, local ranchers and national forest permittees contribute to the social well-being and economic sustainability of the local community. These families participate and support many local activities and community tourism events. The local communities depend on rangeland resources for their livelihood by meeting the public needs for interrelated resource uses such as livestock and wildlife forage, terrestrial and aquatic wildlife habitats, outdoor recreation, and healthy watersheds.

Economic sustainability of these ranches owned by permittees over the next 20 years is the most difficult to predict. Their future will depend on the ability to maintain a viable and profitable livestock operation based on the availability of a sustainable forage base. Ranchers are already faced with the need to manage for diverse goals and have been encouraged to produce products with a higher market value, such as organic and natural meats. In most cases, it is the herd size authorized in the Forest Service grazing permit that limits the ability of many permittees to rely on ranch income alone. Each permit has a certain capacity, resulting in a set number of permitted livestock that the range can support for the season of authorized use. Many permittees have

[56] P.L 104-19, section 504(a)

already diversified their operation to supplement their income from part-time to full-time off-ranch work.

In order to cope with reductions of National Forest System lands for summer grazing, ranchers favor leasing more private land. However, these lands are in short supply and there is strict competition for the leases. In a 2002 University of California Berkeley report to the Sierra Nevada Alliance, 40 to 50 percent of ranching income was attributed to their access to these summer grazing lands. Those interviewed who graze on National Forest System lands said they have no desire to sell their ranches, but a third stated that they would have to consider selling if they lost their Forest Service grazing permit. The majority of ranchers surveyed responded that living and working amidst natural beauty was a highly important reason to continue ranching, and that although ranching is not seen as the ideal way to make a living, most ranchers want their children to continue ranching and to pass on the family tradition (Sulak and Huntsinger 2002).

Analysis and Methods

Analysis Area

While the analysis area consists of all National Forest System lands within the Inyo National Forest, the primary focus includes lands identified as suitable for livestock production.

Lands Suitable for Production Livestock Grazing

Lands identified as suitable for livestock production include National Forest System lands not administratively withdrawn that have been identified in grazing allotments. The status of grazing allotments is either active or vacant. Active allotments have current grazing permit holders authorized to graze the designated allotment. Vacant allotments have no existing permit holder and are generally suspended from grazing until environmental analysis to reactivate the allotment has been completed. A project level suitability analysis would also be done prior to an allotment re-activation. Approximately 852,201 acres within National Forest System lands administered by the Inyo National Forest are considered suitable for livestock grazing and production. Of those lands, approximately 275,744 acres or 32 percent are in vacant status. See Appendix D (table D-1 and figure D-1) for a summary of current allotments and a map of lands not suitable for production livestock.

Grazing

Lands identified as not suitable for livestock production include National Forest System lands administratively withdrawn from production grazing where the allotments have been closed and are no longer delineated. Lands not suitable for livestock production are those lands where livestock grazing has been found to be incompatible with the desired conditions or result in substantial and permanent impairment of the land. Approximately 1,216,142 acres or 59 percent of National Forest System lands administered by the Inyo National Forest are considered not suitable for livestock grazing and production. Suitability determinations were carried forward unchanged to the revised plan. See Appendix D, map Figure D-1 for an illustration of lands not suitable for livestock production.

Temporal Scale

The analysis period consists of two decades (20 years). Discussion on climate change extends to 50 years.

Indicators and Measures

The primary indicators used in rangeland management, both regionally and nationally, are:

- Livestock grazing use as measured by amount of animal unit months (AUMs) permitted annually as a measure of forage consumed.
- Rangeland vegetation Improved as measured by area in acres of allotments maintained at or improved towards desired conditions.
- Forest plan consistency as measured by area in acres of allotments being administered to forest plan standards and guidelines and number of active allotments that have NEPA completed in accordance with the 1995 Rescission Act, P.L.104-19 section 504.

Measures used in this analysis and forest plan monitoring:

- Amount of animal unit months permitted annually as a measure of forage consumed.
- Area in acres of allotments maintained at or improved towards desired conditions.
- Area in acres of allotments being administered to forest plan standards and guidelines.
- Number of active allotments that are NEPA compliant.

Assumptions

- Previous grazing suitability determinations are carried forward for this plan revision. The final decision to authorize or discontinue livestock grazing at the allotment level is made following project-level environmental analysis.
- If implementation of current grazing management standards and guidelines from the forest plan (USDA Forest Service 1988a), as amended (USDA Forest Service 1995, 2004a) were to continue, vegetation and watershed conditions trends are expected to meet or move towards desired conditions for the next 20 years. Monitoring and adaptive management are used to adjust management to maintain and improve rangeland resources.
- Acres administered to standard includes the complexity of permit administration workloads where a more complex workload is reflected by fewer acres administered to standard as compared to a less complex workload.
- It is assumed that commercial livestock grazing opportunities on the Inyo National Forest will be constrained at or near current levels. Opportunities for domestic sheep grazing will remain static or decline if there is expansion of occupied bighorn sheep habitat.
- It is assumed that average forage production will likely decline over time with warmer temperatures, and increased frequency and duration of drought conditions as projected by climate modeling (Vose et al. 2016). Local demand for production livestock forage will exceed forage being made available and authorized.

Affected Environment

As described in the 1988 forest analysis (USDA Forest Service 1988a), bitterbrush (115,409 acres), big sagebrush (160,000 acres) and wet meadows (26,000 acres) are the mainstay of the rangeland resource. They account for an estimated 80 percent of the Inyo's grazing outputs. It further states:

> . . . approximately 3,900 acres of suitable range brush would need to be rejuvenated each year to maintain current grazing outputs (27,000 AUMs in 1988) from brush types over the next fifty years.

Also that:

> Increases in forage are ultimately limited by physical, biological and statutory factors. Most of the rangeland on the Forest is arid (receiving an average of nine to fifteen inches of precipitation per year) and high in elevation (much of it above 7,000 feet) with a growing season of three to four months. Most soils are derived from granitic or volcanic parent rock and have low water-holding capacity. Lack of water and a short growing season limit the growth of forage plants. Finally, much of the highest quality wet meadowland is in the Golden Trout Wilderness (Kern Plateau). Grazing in wilderness is restricted to levels that are compatible with wilderness values."
>
> The demand for grazing on the Inyo is expected to continue at or above present levels, since National Forest summer range is essential for local ranch operations. The Forest Service assumes that if additional AUMs were made available, they would be utilized by present permittees."
>
> The domestic livestock program is currently managed at (low to) moderate level of intensity. Most range allotments have some improvements (such as fences or vegetation treatments) but the improvements are not sufficient to optimize livestock utilization of forage (USDA Forest Service1988a).

Special Aquatic Features

There are a total of 1,479 meadows on the Inyo National Forest of which 384 meadows are in active grazing allotments and 202 meadows in vacant grazing allotments (Roche et al. 2015 and USDA Forest Service 2017d). Meadows occupy between 26,000 and 50,000 acres on NFS lands, depending on the definition and the scale of mapping. When dry alpine or subalpine meadows are included, the area is increased. The landscape of meadows extent depends on location. There have been no systematic condition assessments of all the meadows on the Inyo National Forest. Researchers sampled ten randomly selected meadows on the Inyo National Forest, as part of a Sierra Nevada study (Fryjoff-Hung and Viers 2013). Otherwise, assessments have focused on key grazing area meadows within active grazing allotments and packstock use areas. Rangeland conditions for these are described below. The condition rating of key grazing areas may not represent overall condition of special aquatic features across the national forest (Assessment USDA Forest Service2013a).

There are a total of 235 known fens on the Inyo National Forest. Generally, these fens are found within the larger meadow complexes. A total of 129 fens are within grazing allotments; 59 in active allotments and 70 in vacant allotments (Roche et al. 2015 and USDA Forest Service 2017d). Within these meadow complexes fens play an important role in nutrient cycling and groundwater discharge, provide habitat for rare species, and are a major sink for atmospheric carbon (Weixelman and Cooper 2009). Proper functioning condition information for fens indicated that most either were properly functioning, or had an upward trend, or no trend. A small proportion was found to have a downward trend.

Current Rangeland Conditions

As reported in the Final Inyo National Forest Assessment (USDA Forest Service 2013a), within the last 10 years, condition data has been collected from key areas on 32 allotments on the Inyo National Forest. Data includes vegetation condition, watershed condition, and stream channel assessments. Because of the varied differences in rangeland types, the allotments have been grouped into similar ecosystem types to facilitate management. These groups are Kern Plateau, Desert Allotments, Crowley Lake, Mono Lake, White Mountain, Bishop, and Inyo Mountain. Ratings for vegetation across the Inyo show that 103 key areas (68 percent) fall within the desired condition for vegetation across the national forest. Twenty-seven key areas (26 percent) are in fair condition, and six key areas (6 percent) are in poor condition.

The Inyo National Forest Rangeland Condition Evaluation Process includes a Vegetation Condition Assessment and a Watershed Condition Assessment. Watershed condition ratings show that 71 key areas (50 percent) rate as fully functional, 47 key areas (33 percent) rate as functioning at risk, 29 key areas (20 percent) rate as degraded and six key areas (4 percent) rate as non-functional. For stream reaches within grazed allotments, 67 reaches (59 percent) are properly functioning, 42 reaches (37 percent) are functioning at risk (with different trend ratings), and five reaches (5 percent) are non-functioning.

While generally good, rangeland conditions vary throughout the Inyo, based on data collected to assess vegetation conditions, watershed function, and hydrologic function. The Inyo National Forest conducts annual monitoring of range best management practices to evaluate impacts to water quality and aquatic habitat. Of the total 24 range allotment evaluations conducted, 16 were rated as both implemented and effective. Another four rated as implemented at risk, meaning that although the best management practices were correctly implemented, minor departures from effectiveness were noted. The remaining four evaluations were rated implemented but not effective, meaning that although the best management practices were implemented as planned, they were not effective in preventing adverse effects on water quality.

Effectiveness of Current Grazing Direction and Information Gaps

In 2012, the Forest Service and the University of California Davis Rangeland Watershed Laboratory established a partnership to conduct the first comprehensive analysis of the long term monitoring program dataset conducted by the Forest Service between 1997 and 2015 on montane meadows in the Sierra Nevada; the set of data has included monitoring sites on the Inyo National Forest.

Oles et al. (2017) examined modern conservation strategies that better balance riparian conservation and livestock production objectives on national forest lands. Oles et al. found that changes in plant community were not associated with livestock stocking rates or precipitation at the allotment scale. However, changes in both factors significantly affected changes in plant communities at the meadow scale. Their findings suggest reductions in stocking rates have improved the balance between riparian conservation and livestock production goals. However, changing climate conditions (reduced snow packs and change in timing of snowmelt) may negate those benefits at specific sites and adaptive site-specific management strategies are required to meet grazing pressure limits and safeguard ecosystem services.

Specific to the Inyo National Forest, Freitas et al. (2014) examined the same Forest Service data set for 25 monitoring sites on the Kern Plateau within two vacant allotments and two active allotments. Freitas et al. concluded that riparian conservation grazing strategies implemented on the active allotments neither degraded nor hampered recovery of meadow conditions relative to non-grazed meadow conditions in the vacant allotments.

UC Davis, in partnership with the Forest Service is continuing the process of examining these data to determine meadow conditions and trends, and relationships between meadow conditions and trends, livestock management, weather and environmental drivers. When new information becomes available, it will be used to inform the analysis supporting plan revision as applicable. An ongoing project by the UC Davis Rangeland Watershed Laboratory titled "Meadow Conditions on National Forest Grazing Allotments" represents the most scientifically updated assessment of trend and response to grazing management, as well as to weather and other factors on national forest meadow and riparian rangelands. Meadow health will be assessed using the rooted frequency (Bonham 2013) data to calculate a suite of indicators of meadow condition and trend, including species richness, diversity (Simpson's and Shannon-Wiener indices) and evenness. Soil stability scores (Burton, Smith, and Cowley 2010, Winward 2000) will also be calculated from plant functional trait groups, which are based on life form, life span, plant height, growth form (clonal or not), and nitrogen fixing ability. Current status of the study as well as preliminary analysis of long term monitoring sites on the Inyo National Forest can be found at the UC Davis Rangeland Watershed Laboratory website: http://rangelandwatersheds.ucdavis.edu/main/projects/sierra_nevada_meadows_analysis.html.

Patterns of Rangeland Drought

As stated in the "Climate Change" section of this document, mean annual temperatures in the plan area have increased in the last several decades, mostly with increased nighttime temperatures (Mallek, Safford, and Sawyer 2012). At higher elevations, overall snowfall and spring snow water equivalent (amount of water in snowpack) have remained steady in most southern Sierra Nevada areas, but snowmelt occurs earlier in the year. Changes in temperatures and amounts and timing of precipitation have led to earlier peak stream flow rates in most Sierra Nevada streams, with higher spring flows and lower summer flows. Warming temperatures are leading to glacial recession across the southern Sierra Nevada.

As noted by (Vose, Clark et al. 2016) since 1982, the southern part of the United States has exhibited unfavorable trends in growing conditions resulting from warmer temperatures and decreasing precipitation. During that period the Inyo National Forest showed moderately high increases in temperature while precipitation has been decreasing (years 1982-2012). Also, moderately high decreases in vegetation abundance (years 2000-2013). Reeves (2016) reported cumulative drought (years 2000-2015) and corresponding reductions in biomass to vary from low to moderately high across the Inyo National Forest grazing allotments.

Environmental Consequences

Since the 1988 Inyo National Forest Land and Resource Management Plan was implemented there have been three forest plan amendments in 1995, 2001 and 2004 with specific updates in direction to production livestock grazing (USDA Forest Service 1995b, 2004a). Amendment 6 in 1995 emphasized establishing proper utilization level base on desired vegetation conditions and proper function condition on grazable rangelands. In 2001 and 2004 the emphasis was focused on using adaptive management to improve riparian conservation and achieve proper hydrologic function of riparian systems and watersheds, in addition to conservation of high value aquatic and wildlife habitats like aspen and willow plant communities. The 2001 and 2004 amendments complemented the goals and objectives already in place under the 1995 plan amendment.

All active grazing permits have incorporated allowable utilization levels based on the rangeland assessments described in the 1995 plan amendment; additional adjustments have been made to grazing permits consistent with the 2004 plan amendment. In addition to these two previous plan amendments there have been incremental adjustments to the grazing program when addressing specific grazing impacts on federally listed species. Management terms and conditions required as a result of consultation with U.S. Fish and Wildlife Service and their authorized incidental take, have been incorporated in the term grazing permits where applicable. Also, since 2013 the Inyo National Forest has implemented Sage-grouse Interim Management Policy. Additional changes have also been made for other regional forester listed sensitive species.

Consequences Specific to Alternative A

Livestock Grazing Use

Under alternative A there would be no change to the existing management direction for livestock grazing. Current management direction for term grazing permits and allotment management plans remain in place. New permits and management plans would follow direction identified in the Inyo forest plan, amendment 6 (USDA Forest Service 1995), thought by some to be too prescriptive, unnecessarily complex, and based on use of outdated methods. There would be no anticipated change in overall permitted use from existing conditions unless identified during project-level environmental analysis. Commercial livestock grazing opportunities on the Inyo National Forest will continue to be constrained at or near current levels. Opportunities for domestic sheep grazing will remain static or decline if there is expansion of occupied bighorn habitat within the next 20 years. Interim forest guidelines for management of bi-state sage-grouse habitat would stay in effect under alternative A. No active allotments are within Yosemite toad habitat therefore management direction specific to those habitats does not apply under alternative A.

Permitted livestock use could decline over the next 50 years with warmer temperatures, and increased frequency and duration of drought conditions and more frequent and larger wildfires. There would be potential for a slight downward trend in permitted animal unit months due to annual grass type conversions accompanied with a corresponding increased complexity in permit administration and grazing management. Existing local demand for production livestock forage will exceed forage being made available and authorized.

Under alternative A there would be no additional wilderness designation recommended. Allotment grazing levels and the commitment of forage resources to grazing would continue to be assessed and determined at the project (allotment) level during environmental analysis. Existing wilderness designation would continue to prohibit access by motorized vehicle and mechanized equipment for maintenance of stock water developments, salt placement and potentially restrict installation of new range improvements (such as water troughs) unless approved following a minimum requirements decision. Overall, the annual operating costs to the current permittees would remain static.

Rangeland Vegetation Improved

If implementation of the current Inyo National Forest grazing management strategy (USDA Forest Service 1995) were to continue, vegetation and watershed condition trends are expected to improve, or continue to improve, for the next 20 years, particularly within riparian conservation areas. In terrestrial ecosystems, moderate change is anticipated under all alternatives in amount and extent of annual grass conversions due to climate change and trend in large wildfires as modeled during the next mid-century (2035-2064). The highest probability of percent change due to large wildfires is highest under alternatives A and C and less under alternatives B and D with restoration efforts in the foothill, montane and Great Basin ecological zones which correspond with the location of active grazing allotments.

Adaptive management, which is a key component of the Inyo forest plan, amendment 6 (1995), rangeland assessment process, allows managers to take action to adjust utilization allowances or even grazing management strategies to facilitate the upward trend of meadow and upland grazing sites. However, any future deviation or updating of the forest plan rangeland analysis process would require other forest plan amendments. Improved meadow, riparian and upland sites will result in increased forage available to grazing animals, along with improved overall ecological health of rangelands, which benefit native fauna as well. This may offset anticipated declines in forage production due to climate change and annual grass conversions during the next mid-century (50 or more years).

Consequences Common to Alternative B, B-modified, C, and D

Livestock Grazing Use

Under alternatives B, B-modified, C, and D there would be several updates to the existing management direction for livestock grazing as compared to alternative A. Current management direction for term grazing permits and allotment management plans would be updated where applicable for changes in design criteria for disturbance to stream banks, lakeshores and fens. New permits and management plans would follow direction identified in the final revised Inyo forest plan, chapter 2 "Forestwide Desired Conditions and Management Direction," "Rangeland Livestock Grazing." In the plan revision alternatives, grazing standards are similar though simplified and incorporate updates to the regional rangeland plant list (R5-TP-042, USDA Forest Service 2017). Procedures for conducting rangeland condition evaluations, used to determine allowable utilization standards, would be moved from the existing forest plan into an Inyo National Forest supplement to the regional rangeland analysis and planning guide as described in the "Rangeland Management Supplemental Report" (Frolli and Sims Specialist Report, January 2018, planning record) and incorporate the most recent agency rangeland and watershed evaluation methods. There would be no anticipated change in overall permitted use from existing conditions unless identified during project-level environmental analysis. Commercial livestock grazing opportunities on the Inyo National Forest will continue to be constrained at or near current levels. Opportunities for domestic sheep grazing will remain static or decline if there is expansion of occupied bighorn habitat. Forest guidelines for management of bi-state sage-grouse habitat would be more implementable under alternative B-modified compared to alternatives B, C, and D. All four plan revision alternatives have more adaptable management direction then alternative A. They also would reflect changes in direction that had been incorporated into existing grazing permits and allotment management plans in the past. No active allotments are within Yosemite toad habitat therefore management direction specific to those habitats does not apply under any alternative.

Under alternatives B, B-modified, C, and D permitted livestock use could decline over the next 50 years with warmer temperatures, and increased frequency and duration of drought conditions and more frequent and larger wildfires. There would be potential for a slight downward trend in permitted animal unit months due to annual grass type conversions accompanied with a corresponding increased complexity in permit administration and grazing management. Where feasible and suitable, grazing can be used as a tool to reduce vegetation build-up to lower the risk of unwanted wildfire. Post-fire burned areas, within suitable grazing allotments would be evaluated to determine appropriate rest for vegetation recovery and adjustments to permitted grazing from available forage. Existing local demand for production livestock forage will exceed forage being made available and authorized.

Rangeland Vegetation Improved

Under alternatives B, B-modified, C, and D if implementation of this modified Inyo National Forest grazing management strategy were to continue, vegetation and watershed condition trends are expected to improve, or continue to improve, for the next 20 years, particularly within riparian conservation areas. In terrestrial ecosystems, moderate change is anticipated under Alternatives B and B-modified in amount and extent of annual grass conversions due to climate change and trend in large wildfires as modeled during the next mid-century (2035-2064). Alternatives B, B-modified and D would have lower probability of percent change due to large wildfires as compared to alternatives A and C due to restoration efforts in the foothill, montane and Great Basin ecological zones which correspond with the location of active grazing allotments.

Under alternatives B, B-modified, C, and D, adaptive management is a key component of the grazing management strategy which allows managers to take action to adjust utilization allowances and grazing management strategies to facilitate the upward trend of meadow and upland grazing sites. These alternatives also allows future updates rangeland and watershed evaluation methods to incorporate best available science and new information in a timely manner. Improved meadow, riparian and upland sites will result in increased forage available to grazing animals, along with improved overall ecological health of rangelands, which benefit native fauna as well. This may offset anticipated declines in forage production due to climate change and annual grass conversions during the next 50 or more years.

Cumulative Environmental Consequences

Fire Management. Under alternatives B, B-modified, C, and D where feasible and suitable, grazing can be used as a tool to reduce vegetation build-up to lower the risk of unwanted wildfire. Post-fire burned areas, within suitable grazing allotments would be evaluated to determine appropriate rest for vegetation recovery and adjustments to permitted grazing from available forage.

Ecological Integrity. Under alternatives B, B-modified, C, and D, for the bi-state greater sage-grouse species-specific plan direction is added. The forest plan direction is based on the existing "Inyo National Forest Sage-Grouse Interim Management Policy" (USDA Forest Service 2012c) and, where appropriate, additional management direction has been developed consistent with the "Humboldt-Toiyabe National Forest Greater Sage Grouse Bi-State Distinct Population Segment Forest Plan Amendment." The revised forest plan also includes management direction and emphasizes management actions that are consistent with the now updated "Bi-State Action Plan: Past, Present, and Future Actions for the Conservation of the Greater Sage-Grouse, Bi-State Distinct Population Segment."

Acres of sage-grouse habitat improved are projected to be highest under alternatives C and D at 22,350 acres, less for alternatives B and B-modified at 14,900 acres, and lowest under alternative A at 7,450 acres. Acres of riparian ecosystems restored is projected to be highest under alternative C at 600 acres of meadow and 20 miles of streams restored; it is slightly lower under alternatives B, D, and B-modified at 500 acres of meadow and 20 miles of streams restored. Ecological restoration will contribute to the sustainability of grazing on the Inyo National Forest. Restoration of sage-grouse and aquatic habitats will remain a priority under all alternatives. Under all alternatives short-term impacts from restoration efforts may be adverse to individual permittees at the allotment scale if temporary changes in livestock management are needed to minimize disturbance on these sites. However, long-term impacts under all plan revision alternatives would be beneficial once restoration objectives have been reached; such benefits as sustaining desired forage plant species and permitted grazing levels over time.

A rangeland condition and biodiversity assessment on national forests within the region is in progress by Forest Service and University of California Davis to estimate trends over the last 20 years. Over 800 monitoring sites have been established on the national forests in California since 1999. Results from this study are expected in the near future which will provide a more meaningful assessment of rangeland condition and trend and response to grazing management, as well as to weather and other factors. Alternatives B, B-modified, C, and D would provide the best means of adjusting rangeland and watershed evaluation assessments or adapting management to any new information from these monitoring efforts. Alternative A would require an amendment to the forest plan to adjust to rangeland and watershed evaluation assessments and possibly delaying adaptive management responses.

All five alternatives continue existing design criteria for management and protection of fens. A management indicators technical guide has recently been developed to assess ground disturbance and it provides managers and livestock producers a quantifiable measure of permitted disturbance levels on these special aquatic features and the need to move or remove livestock if disturbance levels are exceeded. Alternatives B, B-modified, C, and D provide an additional riparian conservation standard to limit disturbance on fens from livestock annually at 15 to 20 percent and make further adjustments if fen conditions are trending downward.

Conservation Watersheds. Area-specific management area plan components for watersheds seek to attain water quality for state-designated beneficial uses and to retain integrity of the aquatic systems. In general, forestwide watershed conditions are fully functioning, with connectivity (WTR-FW-DC 02, WTR-FW-STD 01). Conservation watersheds, a subset of watersheds, include, in addition, plan components to benefit habitat for at-risk species, mostly Species of Conservation Concern. They are important places to protect these species, and the networks of connected waterways to help provide resilience in the face of large scale catastrophic events. They are areas where first of all, we seek to maintain high quality water, but where we would undertake restoration if in fact, we thought it could improve the resilience of the populations by diminishing risks and/or establishing connectivity where appropriate.

As shown in table 110, under alternative A there would be 98,085 acres of critical aquatic refuge management areas within active and vacant grazing allotments. Under alternatives B and D there would be a 20,476-acre (21 percent) increase in critical aquatic refuge management areas compared to alternative A. Under alternative C there would be a 75,332 acre (77 percent) increase in critical aquatic refuge management areas compared to alternative A. For alternative B-modified, conservation watershed management areas would occur on 223,288 acres within active and vacant allotments. Conservation watersheds would replace existing critical aquatic refuge management areas. Within grazing allotments, under alternative B-modified there would be a 125,203-acre (128 percent) increase in area-specific watershed management as compared to alternative A.

Under Alternative B-modified, Conservation Watershed plan components do not directly prohibit livestock grazing activities or restrict or limit this use. Forest Plan components for these management areas allow for the continued use of livestock and do not prescribe additional standards that would necessarily increase burden on livestock operations or limit the variety of management options available to livestock grazing operations.

Table 110. Comparison of critical aquatic refuge and conservation watershed management areas within active and vacant grazing allotments

Alternative	Management Area	Within Active Allotments	Within Vacant Allotments	Within Allotments
Alternative A (critical aquatic refuges)	171,395	32,674	65,411	98,085
Alternatives B and D (critical aquatic refuges)	192,362	53,150	65,411	118,561
Alternative C (critical aquatic refuges)	324,533	107,535	65,882	173,417
Alternative B-Modified (conservation watersheds)	387,677	94,732	128,556	223,288

During implementation of restoration actions within conservation watersheds, specific project design features may be created to reduce the impacts of livestock grazing to restoration efforts (for example, meadow restoration where willows are planted); to ensure that grazing activities promote attainment of functional watershed condition indicators, consistent with the purpose of the conservation watershed. Under all alternatives the impacts of these design features to livestock grazing would be determined, and analyzed, at the project level. The forest plan contains standards and guidelines that apply to livestock grazing within Riparian Conservation Areas. Standards MA-RCA-STD 01, 07, 10-14, 17 and 19 and guidelines MA-RCA-GDL 02, 03, and 05 would apply at the project level. The following components also apply: RANG-FW-STD 04 and RANG-GDL-04 thru 07. These are not new standards and guidelines and are adapted from the 1988 Inyo Land and Resource Management Plan and 2004 Sierra Nevada Forest Plan Amendment. Where conservation watersheds overlap with designated wilderness, DA-WILD-GDL 02 related to stock use, applies.

In summary, under alternative B-modified grazing activities would not be constrained by conservation watersheds. Under alternatives B, B-modified, C and D grazing could be affected by other plan direction that calls for maintaining or improving the quality or quantity of watershed resources, such as water quality, while ensuring sustainable continuation of multiple uses.

Recommended Wilderness. Alternative C includes 325,359 acres of new recommended wilderness. Alternatives B and B-modified include a much lower amount of new recommended wilderness at 37,029 acres. Alternatives A and D have zero new recommended wilderness. Under alternatives B, B-modified, and C these recommended wilderness additions, if designated by Congress, would restrict vehicle access to four (4) active cattle allotments. Wilderness designation would not restrict current permitted grazing levels. However, wilderness designation would prohibit access by motorized vehicle for maintenance of stock water developments, salt placement and restrict installation of new range improvements (such as water troughs) unless approved following a minimum requirements decision.

Other issues that can arise after a wilderness designation include limited ability to propose new rangeland improvements such as water developments or drift fences which can hinder the ability to reach desired rangeland conditions. Also, widely held public expectations of pristine conditions beyond those conditions used by the Forest Service to describe wilderness character (see "Revision Topic 3: Sustainable Recreation and Designated Areas;" also appendix B) often lead to frustration in seeing livestock in a wilderness setting. Hazing or malicious harassment of authorized livestock in wilderness by some visitors has become more frequent in recent years.

Effectively controlling livestock herds under these circumstances can often require doubled up workloads by the grazing permittees (Sims pers. Communication). Adverse effects under alternative C, if designated by Congress, would be greater than alternatives B and B-modified. Overall, the annual operating costs to the current permittees would have the potential to increase under these conditions. The extent of these effects is uncertain at this programmatic level.

Benefit to people and communities. The forestwide rangeland management goal to provide stability to local ranching communities would continue under all alternatives. Under alternatives B, B-modified, C, and D a desired condition is added to provide for open space, grazable landscapes, rural landscapes and cultural heritage. Under alternative A, long-term impacts to grazing opportunities could result from no increase in restoration activities to reduce the risk of uncharacteristic wildfires or to improve forest and rangeland health. Under alternatives B, B-modified, C, and D short-term impacts from restoration efforts may be adverse to individual permittees at the allotment scale with long-term benefits once restoration objectives have been reached.

Analytical Conclusions

Under all alternatives, there is no change in rangeland suitability acres. Any adjustments to suitability analysis and subsequent suitability determinations would involve project-level environmental analysis.

All alternatives would continue authorized grazing at current levels over the 20-year analysis period. Alternatives B, B-modified, C, and D would have modest improvements in riparian conservation areas and resilience to disturbance and climate change at the allotment level. Landscape resilience would continue to decline over the next mid-century in the foothill, montane and Great Basin ecological zones due to upward trends in large wildfire, annual grass conversion, and climate change and prolonged patterns of persistent drought. Permitted livestock use is likely to decline over the next 50 years.

Alternatives B, B-modified, C, and D provides more design criteria then the alternative A in using timely adaptive management. Under these alternatives forest plan design criteria are slightly less prescriptive. Utilization standards are simplified into fewer categories. Rangeland assessment processes are removed from the forest plan and placed in a forest supplement to the regional rangeland analysis and planning guide. This approach would allow timely updates to rangeland assessment procedures using best available science and new information.

Alternative A would retain some adaptive management features though more constrained than alternatives B, B-modified, C and D due to fixed rangeland analysis procedures which do not account for best available science regarding unforeseeable changes and information gaps or the uncertainty of ecosystem response to climate change, wildfires, and other factors.

Under all alternatives short-term impacts from restoration efforts would be offset by long-term benefits, such as sustaining permitted grazing levels over time, once restoration objectives have been reached.

Wilderness designation of those areas recommended under the alternatives would not be expected to restrict current permitted grazing levels differently than under the current forest plan. Allotment grazing levels and the commitment of forage resources to grazing would continue to be assessed and determined at the project (allotment) level during environmental analysis. Wilderness designation would prohibit access by motorized vehicle and mechanized equipment for maintenance of stock water developments, salt placement and potentially restrict installation of new range improvements (i.e. water troughs) unless approved following a minimum requirements decision. Overall, the annual operating costs to the current permittees would have the potential to increase under these conditions. The extent of these effects is uncertain at this programmatic level.

Wild Horses and Burros Territory Management

Three administratively designated wild horse and burro territories occur on the Inyo National Forest: Montgomery Pass and White Mountain Wild Horse Territories; and Saline Valley Wild Burro Territory in the Inyo Mountains Range (see appendix D, figure D-2). These three territories were established with the passage of the Wild Horse and Burro Act of 1971. Management of wild horse and burro territories is guided by individual management plans.

The wild horse and burro territories are managed as part of the Rangeland Management Program. The desired conditions grazable rangelands within these territories are similar to those for livestock grazing allotments. The desired conditions for grazable rangelands and management are:

1. Rangelands, along with grazable forestlands and woodlands, provide large areas of contiguous space supporting native vegetation that has the potential to be grazed. These grazable landscapes sustain biological diversity and ecosystem integrity and help to preserve the rural landscape and cultural heritage of the central, southern and eastern Sierra Nevada.
2. Forage, browse, and cover meet the needs of wildlife and wild horses and burros are managed in balance with available forage. Areas that are grazed have or are trending toward having satisfactory soil conditions, functional hydrology and biotic integrity.
3. Wild horse and burro grazing maintains the desired rangeland vegetation types represented by diverse plant functional groups, species richness and diversity, and structure and condition of plant communities.
4. The Forest Service national policy objective is to maintain wild free-roaming horse and burro populations in a thriving ecological balance in the areas they inhabit on National Forests. Specific territory management objectives are described in each of the respective territory plans.

Goal (DA-WHT-GOAL)

1. Continue working with other agencies and Forest Service units, such as the Bureau of Land Management and the Humboldt-Toiyabe National Forest, and other partners or collaborative groups to manage wild horse herds or in the development of wild horse management plans.

Potential Management Approach

- Continue to monitor wild horse populations to determine numbers and use.

Background

Management History

All of the feral horses and burros that now inhabit North America are probably derived from stock that escaped or were released from ranchers, miners, or Native Americans (Berger 1986). Few if any of these horses show affinities to the Spanish horses that escaped from Hernando Cortes's 1519 landing near Vera Cruz, Mexico, or Hernando de Soto's 1543 travels on the Mississippi (Wyman 1945).

The wide-spread grazing by livestock, including horses and burros, in the Sierra Nevada's and eastern California would have corresponded with the Gold Rush era followed by widespread grazing into the Sierra Nevada in the mid-1860's (Allen-Diaz et al. 1999).

Montgomery Pass Wild Horse Territory comprises an area of 207,921 acres in California and Nevada, including 65,942 acres on the Inyo National Forest. The remaining territory acres occur on the Humboldt-Toiyabe National Forest, and Stillwater and Bishop Field Offices of the Bureau of Land Management (BLM). It is located east of Mono Lake, in the southern portion of the Excelsior Mountains, approximately 37 miles north of Bishop, California. It crosses the north end of the White Mountains at Montgomery Pass, and is bounded by State Highway 6 to the southeast. It is situated north of State Highway 120 and bounded by Deep Wells Road to the west. The northern boundary in Nevada extends from Granite Springs southeasterly to State Highway 10. The Montgomery Pass Wild Horse Territory Plan was prepared in 1988 (USDA Forest Service). This territory is managed for an Appropriate Management Level (AML) of 138 to 230 wild horses. There are no wild burros in this wild horse joint management area.

White Mountain Wild Horse Territory comprises an area of 265,820 acres in California and Nevada, including 181,820 acres on the Inyo National Forest. The remaining territory acres are associated with the BLM's Fish Lake Valley Herd Management Area that is administered by the Tonopah Field Office in Nevada. The White Mountain Wild Horse Territory Plan was prepared in 1976. This territory is managed for a wild horse herd size of 70 to 80 horses. The territory runs along the east side of the White Mountains crest from Montgomery Pass Wild Horse Territory, along Highway 6 in the north to Highway 168 and Deep Springs in the south. The BLM's Fish Lake Valley Herd Management Area has an established appropriate management level (AML) of 32 to 54 wild horses. There are no wild burros in this wild horse joint management area.

Saline Valley Wild Burro Territory includes 27,721 acres along the eastern slopes of the Inyo Mountains and is associated with the BLM's 23,000 acre Waucoba-Hunter Mountain Herd Management Area has an established herd appropriate management level of 9 to 11 wild burros. The Waucoba-Hunter Herd Management Area borders Death Valley National Park, which is known for its hot and dry terrain. The Saline Valley and Lee Flat Burro Herd Management Plan was written in 1985. However, a large portion of this joint management area transferred to the National Park Service with passage of the California Desert Protection Act in 1994. BLM's Lee Flat Herd Management Area (73,000 acres), located east of Mono Lake and south of Waucoba-Hunter Mountain Herd Management Area, is now managed as a separate herd with an AML of 12 to 15 wild burros. BLM is the lead agency for managing these two wild burro herds. There are no wild horses present in the Forest Service territory or either wild burro herd management area.

Potential Grazing Effects to Rangeland Ecosystems

Potential grazing effects from wild horses or wild burros are similar to domestic livestock as described under in the "Production Livestock Grazing" section. However, wild horses and burros have season long grazing patterns. Berger (1986) describes seasonal vertical migration and altitudinal segregation of wild horse bands. Typically there are two distinct seasonal range patterns in the Great Basin; high-altitude summer range (above 2,000 m) and low-altitude fall-winter-spring range. Low-altitude ranges were smaller in size than summer ranges. However, home ranges vary considerably depending on available forage and water resources and weather conditions. In open country with minimal snow depths wild horses and burros occupy the landscape year-round with minimal management which often results in long lasting effects on the vegetation and soil characteristics of rangelands (Beever 2003).

As summarized in the recent bi-state sage-grouse environmental impact statement (USDA Forest Service and USDI Fish and Wildlife Service 2015), prolonged grazing by wild horses has caused plant community changes that can have negative impacts on sage-grouse and other sagebrush-obligate wildlife. Effects from wild horse and burro grazing have been documented to limit sagebrush recruitment, reduce sagebrush density, reduce grass abundance and cover, lower plant species diversity, increase dominance of forbs unpalatable to sage-grouse, and compact surface soil horizons (Beever and Aldridge 2011, Beever and Herrick 2006, Davies, Collins, and Boyd 2014). The effects can be especially pronounced during drought conditions (Beever and Aldridge 2011).

Current Herd Sizes, Distribution and Grazing

In 2015 systematic aerial surveys were conducted by the BLM and Forest Service on all wild horse and burro herd management areas and territories within the habitat range of the bi-state sage-grouse. The simultaneous double-count method with sightability bias correction was used (Lubow and Ransom 2007, 2016). Estimated population sizes were calculated to 90% confidence interval. Survey results (Lubow 2016) are reported below.

Montgomery Pass Wild Horse Territory / Herd Management Area Complex had a population size of 537 horses. An estimated 397 horses or 74% were found to be outside of the designated herd complex. A total of 19 head were within the Wild Horse Territory on the national forest. The population in 2017 is estimated to be 773 horses assuming an annual population growth rate of 20 percent over 2 years. Over the last 5 years, horses have established dispersed bands west of the territory to Mono Lake (Mono Basin National Forest Scenic Area) and east to the Nevada border.

Extensive work by (Turner 2015) has included observation of the Montgomery Pass herd over a 25 year period beginning in 1987. The Montgomery Pass wild horse population was one of few wild or feral horse populations thought to have been self-regulated by mountain lion predation. Based on finding from an 11-year predation study, (Turner and Morrison 2001) reported the resident lion population was significantly influencing number of horses in the Montgomery Pass Complex, primarily through predation of foals. Increased foal survival during the latter part of the 11-year study appeared related to a substantial decrease in number of lions within the territory.

Turner (2015) also documented the long-tern patterns in the natural relationship between the Montgomery Pass wild horses and their environment. He examined environmental impacts on the horse population and its activities, movements and distribution on the range. In Turner's study multiple variables in the physical environment (i.e. available forage and water) and in horse behavior were monitored seasonally. He found distinct summer (high altitude) and winter (lower altitude) range use was characteristic for over 60 percent of the population during the first 7 study years. In subsequent years there was a gradual reduction in use of summer range. Turner estimates that approximately 20 percent of the population continued to annually use the historical summer range. However, the majority of the population divided into two geographically and functionally separate subpopulations that resided year round in the historical winter range and adjacent areas on opposite sides (east and west) of the Montgomery Pass Complex. These findings correspond with horse distribution patterns observed during the 2015 aerial survey (Lubow 2016).

Turner documented that mountain lion predation on foals was restricted to the summer range, and exodus of horses from the summer range resulted in increased foal survival where the horse subpopulations currently reside. Turner concludes that the Montgomery Pass wild horses have been highly adaptive and individually varied in response to environmental pressures; that long-term monitoring of wild horse populations reveals underlying environmental dynamics and their potential management implications.

White Mountain Wild Horse Territory – Fish Lake Valley Herd Management Area Complex had a population size of 188 horses. An estimated 94 horses or 50 percent were found to be outside of the designated herd complex. A total of 72 head were within the Wild Horse Territory on national forest. BLM estimates the Fish Lake Valley population in 2017 to be 149 wild horses (United States Department of the Interior 2017). Overall, very little of the White Mountain Wild Horse Territory is occupied. Horses occupy the north and east foothills of the White Mountain Range along the edge of Fish Lake Valley year around. Single bachelor stallions are occasionally observed during summer on the crest in the center of the territory.

Saline Valley/Lee Flat Wild Burro Territory –Wacoba-Hunter Mountain Herd Management Area Complex was not surveyed during the 2015 Bi-State flight. Wacoba-Hunter Herd Management Area was last surveyed by BLM in 2011 (United States Department of the Interior 2017). BLM estimates the 2017 population at 77 wild burros. It is unknown how many, if any, wild burros from Wacoba-Hunter Herd Management Area are on national forest. Lee Flat Herd Management Area was last surveyed by BLM in 2009 (United States Department of the Interior 2017). BLM estimates the 2017 population at 0 wild burros. It is assumed there are no burros from Lee Flat Herd Management Area on national forest.

Analysis and Methods

Analysis Area

The analysis area consists of all National Forest System lands within the Inyo National Forest within the designated wild horse and burro territories.

Lands Suitable for Wild Horse and Burro Grazing

Lands identified as suitable for wild horses or wild burros are those territories which currently exist and which were inventoried and delineated National Forest System lands in the 1973 following passage of the Wild Horse and Burro Act of 1971. Corresponding lands were identified by the BLM on Federal lands under that agency's jurisdiction.

Lands Not Suitable for Wild Horse and Burro Grazing

Lands identified as not suitable for wild horses or wild burros include all National Forest System lands outside of the three designated territory boundaries of Montgomery Pass Wild Horse Territory, White Mountain Wild Horse Territory and Saline Valley-Lee Flat Wild Burro Territory.

Temporal Scale

The analysis period consists of two decades (20 years). Discussion on climate change extends to 50 years.

Indicators and Measures

The primary indicators used in wild horse and rangeland management, both regionally and nationally, are:

- Wild horse and burro grazing use as measured by annual population estimates and corresponding amount forage consumed, measured in animal unit months (AUMs).
- Rangeland vegetation Improved as measured by area in acres of allotments maintained at or improved towards desired conditions.
- Forest plan consistency as measured by population of wild horses and burros managed to appropriate management levels and that achieve forest plan standards and guidelines.
- Number of active territories which are NEPA compliant and have verified appropriate management level determinations.

Measures used in this analysis and forest plan monitoring:

- Amount of animal unit months (AUMs) used annually as a measure of forage consumed based on estimated population size.
- Area in acres of territories maintained at or improved towards desired conditions.
- Surveyed population numbers and distribution relative to established appropriate management levels and territory boundaries; acres of territories being managed to forest plan standards and guidelines.
- Number of active territories which are NEPA compliant and have verified appropriate management level determinations.

Assumptions

Several of the assumptions are adapted from analysis presented in the 2015 Humboldt-Toiyabe National Forest Plan Amendment Final Environmental Impact Statement for Greater Sage-grouse (USDA Forest Service and USDI Fish and Wildlife Service 2015)

- Previous territory suitability determinations are carried forward for this plan revision. Any decision to change appropriate management levels or management of a territory is made following project-level environmental analysis.
- Average forage production will likely decline over time with warmer temperatures, and increased frequency and duration of drought conditions as projected by climate modeling (Vose, Clark, et al. 2016). Future changes in abundance and availability of essential habitat components (forage, water, cover and space) may require changes to appropriate management levels.
- Territories, when managed to designate appropriate management level, will achieve a thriving natural ecological balance and meet yearlong wildlife habitat needs.
- Wild horses and burros are dependent on the herbaceous component of a shrub/grass plant community. Encroachment of shrubs or pinyon and/or juniper onto established range lands are adverse, whereas increases in grasses and forbs are beneficial. Vegetation treatments

such as prescribed burns or weed control can enhance the plant community composition and forage availability.

- Continuous, year-ling wild horse and burro grazing will adversely affect plant composition, plant succession, and ground cover.
- Water is the primary resource associated with wild horse and burro distribution. Water developments can improve wild horse and burro distribution. However, failed water developments can cause wild horses and burros to disperse outside the territory in search of other water sources.
- Wild horse and burro distribution will and can vary by season, climatic conditions, water and forage availability, and population size.
- Intensive livestock grazing management strategies (scheduled pasture rotations) that involve project infrastructure (fences) are generally not appropriate for long-term wild horse management.

Affected Environment

The affected environment is limited to the three designated wild horse and burro territories described above under “Management History.”

Current Rangeland Conditions

Over all rangeland conditions for the White Mountain and Inyo Mountain groups are described in the Production Livestock section.

Effectiveness of Current Management Direction and Information Gaps

The territory management plans for these three territories pre-date the 1988 forest plan and are in need of being updated. An inventory of existing resource conditions and four essential habitat components (water, forage, cover and space) is needed. A comprehensive analysis and adjustment of appropriate management levels is also needed for each territory which corresponds with current management of adjoining BLM Herd Management Areas. The wild horses from Montgomery Pass and White Mountain are predominantly outside each designated territory as established in 1971; burro abundance and distribution within Saline Valley Wild Burro Territory is unknown. Management strategies are needed to encourage re-occupancy of those territories and discourage establishment dispersed sub-populations outside of the territory/Herd Management Area complexes.

Patterns of Rangeland Drought

Refer to the “Production Livestock Grazing” section for this discussion.

Environmental Consequences

Consequences Common to Alternatives A, B, B-modified, C, and D

Under all alternatives management actions for wild horses and burros would remain unchanged until a territory-specific environmental analysis is conducted. There would be no direct changes to wild horse and burro territory status or designation, to established appropriate management levels, or acreage designated as wild burro territories.

Under alternative B, B-modified, C, and D where sage-grouse habitat is being degraded due to wild horse use site-specific measures would be determined to improve or restore sage-grouse habitat. Impacts would be limited to any future changes that may result in appropriate management level and/or acreage adjustment as well as possible reconsideration of territory designations that are based on achievement of sage-grouse habitat objectives for improving habitat conditions.

Wild horse and burro grazing has similar impacts as livestock grazing in their effect on soils, vegetation health, species composition, water, and nutrient availability by consuming vegetation, redistributing nutrients and seeds, trampling soils and vegetation, and disrupting microbial systems (Connelly et al. 2004). As noted previously, wild horses and burros occupy the landscape year-round with minimal management which often results in long lasting effects on the vegetation and soil characteristics of rangelands (Beever 2003). Those conditions exist on the Montgomery Pass and White Mountain Wild Horse Territories. Impacts appear to be on public and private lands outside of these territories and off the national forest.

Rangeland Vegetation Improved

If management of each wild horse and burro territory to appropriate management level were implemented and the current Inyo National Forest grazing management strategy (USDA Forest Service 1995a) were to continue, vegetation and watershed condition trends are expected to improve, or continue to improve, for the next 20 years, particularly within riparian conservation areas.

In terrestrial ecosystems, moderate change is anticipated under all alternatives in amount and extent of annual grass conversions due to climate change and trend in large wildfires as modeled during the next mid-century (2035-2064). The probability of percent change due to large wildfires is highest under alternatives A and C and less under alternatives B, B-modified and D with restoration efforts in the foothill, montane and Great Basin ecological zones which correspond with the location of active grazing allotments and wild horse territories.

Cumulative Environmental Consequences

Fire Management. Under Alternatives B, B-modified, C, and D, where feasible and suitable, grazing can be used as a tool to reduce vegetation build-up to lower the risk of unwanted wildfire. Fuels projects that protect existing sagebrush ecosystems and associated sag-grouse habitat would benefit wild horses and burros where the territories overlap with these habitats. However, temporary or long-term management changes to wild horses and burros (such as reduction in appropriate management level, designation, removals, movement patterns, and forage access) may be necessary to achieve and maintain the desired fires management objectives. Prioritizing fire suppression activities to conserve priority sage-grouse habitat would also benefit wild horse and burro habitat.

Ecological Integrity. Refer to the description under Production Livestock Grazing. Restoration of sage-grouse and aquatic habitats will remain a priority under all alternatives. Temporary or long-term management changes to wild horses and burros (such as reduction in appropriate management level, designation, removals, movement patterns, and forage access) may be necessary to achieve and maintain the desired restoration project objectives. Long-term impacts under all alternatives would be beneficial once habitat restoration objectives have been reached; such benefits as sustaining desired forage plant species, grazing levels, and wild horse and burro appropriate management levels over time.

Conservation Watersheds. Refer to the description under "Production Livestock Grazing." Conservation watershed plan components do not directly prohibit wild horse and burro or livestock grazing activities or restrict or limit this use. Forest Plan components for these management areas allow for the continued wild horse and burro territory designation. During implementation of restoration actions within conservation watersheds, specific project design features may be created to reduce the impacts from wild horse and burro grazing to restoration efforts. Temporary or long-term management changes to wild horses and burros (such as reduction in appropriate management level, designation, removals, movement patterns, and forage access) may be necessary to achieve and maintain the desired restoration project objectives.

In summary, wild horse and burro management activities would not be constrained by conservation watersheds. However, grazing could be affected by other plan direction that calls for maintaining or improving the quality or quantity of watershed resources, such as water quality, while ensuring sustainable continuation of multiple uses.

Recommended Wilderness. Under alternatives B, B-modified, and C, new wilderness designation would not restrict management of the wild horse and burro territories. Any future excess wild horse or burro removals would occur at lower elevations outside of existing wilderness area. Like management of grazing allotments, wilderness designation would prohibit access by motorized vehicle for maintenance of water developments and restrict installation of new range improvements (such as water troughs) unless approved following a minimum requirements decision.

Benefit to People and Communities. The effects to the local communities would be the same under all alternatives.

Analytical Conclusions

Under all alternatives rangeland suitability acres for the three designated territories would remain at current levels as illustrated in appendix D. Any adjustments to suitability or population appropriate management levels analysis, and subsequent suitability determinations would be done with environmental analysis at the territory level. It should be noted that a comprehensive analysis and adjustment of appropriate management levels is needed for each territory that corresponds with current management of adjoining BLM Herd Management Areas.

Alternatives B, B-modified, C and D would have modest improvements in riparian conservation areas and resilience to disturbance and climate change at the allotment level. Landscape resilience would continue to decline over the next mid-century in the foothill, montane and Great Basin ecological zones due to upward trends in large wildfire, annual grass conversion, and climate change and prolonged patterns of persistent drought. Appropriate management levels for wild horses and burros are likely to require adjusting to lower population levels over the next 50 years. Alternatives B, B-modified, C and D provide more design criteria then alternative A in using timely adaptive management that may have long-term benefits to wild horses and burros.

Wilderness designation under alternatives B, B-modified, and C would not be expected to restrict current appropriate management level or herd management levels differently than under alternatives A or D.

Economic Conditions

Background

Forest management influences the economic sustainability of the communities that surround Inyo National Forest and impacts the provision of forest benefits that affect the quality of people's lives both locally and further removed from the plan area. This section examines potential effects on the benefits to people by examining potential changes in the key benefits that the national forest provides (such as, recreational opportunities, clean air and water, grazing, species habitat, and energy). Current threats resulting from uncharacteristic wildfire and declining forest health bring into question the long-term sustainability of these important benefits. Plan alternatives that address these concerns are examined as to their potential to improve the sustainability of key forest benefits while also examining the short- and long-term tradeoffs associated with these management actions. The information in this section is a summary of the more detailed Economics supplemental report.

Analysis and Methods

Study Area and Data Sources

The information describing local economic conditions is obtained from "Chapter 6: Assessing Social, Cultural and Economic Conditions" in the individual national forest assessments that were written for plan revision (USDA Forest Service 2013a). Key national forest contributions are examined for the geographic areas where economic activities are supported by National Forest System land management. This area represents the California and Nevada counties where national forests provide opportunity for production of commodities and forest visitation (such as, grazing, mining, and recreation) and also those counties where the Inyo National Forest has made direct expenditures in management (such as, spending on projects and Forest Service employee salaries).[57] This information on key economic contributions of the Inyo National Forest is obtained from the Forest Service Economic Contribution model (USDA Forest Service 2014f).

The Inyo also provides benefits to communities located further away from the administrative boundary (such as, water and electricity) and moreover provide nonmarket benefits where quantifying economic contributions is difficult (such as, biodiversity). The key forest benefits were identified using "Chapter 7: Benefits to People" in the national forest assessment referenced earlier, as well as the national forest "distinctive roles and contributions" statement that was developed for plan revision and is included in the forest plan.

Methodology for Analysis

Potential effects are examined for changes in the benefits of Inyo National Forest across the five plan alternatives. Two separate examinations are conducted: (1) a financial examination looking at the potential for funding management activities and resulting challenges, and (2) a national forest benefits examination looking at potential short- and long-term effects on the key national forest benefits for local economies and improving the quality of people's lives throughout the region.

The financial examination is undertaken to provide decisionmakers with context for the challenges that the Inyo will face funding project implementation under each alternative. The

[57] These are Inyo and Mono counties in California and Esmerelda and Mineral counties in Nevada.

management actions associated with each of the alternatives have consequences for funding that present challenges for the Inyo.

Inyo National Forest benefits examination looks at potential changes in six key forest benefits important for people locally and across the region (water quality and quantity, recreation, air quality, grazing, energy generation and biodiversity). This qualitative analysis examines how these key national forest benefits are indirectly affected by the plan alternatives and what these potential effects mean for people and communities.

Important to this examination of national forest benefits is consideration of the tradeoffs associated with potential short- and long-term effects. Short-term effects would be expected while the types of restoration activities expected under the various alternatives are occurring. These types of effects typically involve restricted national forest access or other consequences to resources (such as sedimentation or smoke) due to activities such as mechanical thinning or use of prescribed fire. Long-term effects would be expected after restoration activities are completed and represent the expected resulting conditions and consequences of these activities on the sustainability of national forest benefits. Examples of these types of long-term effects would be reduced fuel loads and improved forest heath from restoration activities that lower the long-term risk associated with uncharacteristic wildfire, drought, and forest insects and diseases.

The following assumptions are made in conducting these analyses:

- all the potential effects on benefits to people are indirect in nature as the plan is programmatic and does not compel any action to occur or authorize any projects or activities;
- national forest base funding and staffing levels remain constant and representative of current trends across alternatives and for the life of the plan;
- funding for increased restoration and management activities is obtained from outside existing national forest budgets through stewardship contracts and partnership opportunities, and thus represents new money into the local economy; and
- there are no current or expected future changes to mining activities or the associated program as a result of the proposed plan alternatives.

Affected Environment

This section presents:

1. A description of the economic conditions within Inyo and Mono counties in California and Esmerelda and Mineral counties in Nevada where forests provide opportunity for production of commodities and forest visitation and also those counties where the Inyo National Forest has made direct expenditures in management;
2. A description of the key economic contributions the national forest makes that influence these economic conditions and influence economic sustainability; and
3. A description of how these key national forest economic contributions are currently threatened by uncharacteristic wildfire and disease and insect pathogen mortality in vegetation.

Economic Conditions

Economic conditions are described by examining three factors: economic health; economic diversity, and local fiscal conditions surrounding the national forest.

Economic health is the overall health, or prosperity, of an economy and this influences its ability to adapt to change. An economy already facing job loss and low incomes is likely to be less able to adapt to national forest management changes that affect key economic sectors. Three key statistics are presented below as measures of this economic well-being; the annual unemployment rate, average earnings per job, and per capita income.

Economic diversity is the extent to which an economy is dependent on one or only a few sectors as opposed to a broad spectrum of economic activities. When determining the economic context of national forest management decisionmaking, it is important to identify the key sectors that drive the economy and the extent to which the economies of the surrounding area are dependent on national forest land activities. Determining this level of diversification and the economy's dependence on these activities provides a good indicator of the potential effects that may result from national forest management decisions that impact these activities. That is, a more diversified economy that is supported by many different sectors is better able to withstand changes to national forest management than is an economy that is dependent mostly on forest-based commodity extraction and tourism.

Local fiscal conditions represent the finances of local governments, specifically the sources of revenue and the targets of spending. Local governments rely on revenues generated from activities on national forest lands. These revenues can be summarized in three broad categories; direct, indirect, and secondary. Direct includes the direct subventions from the Federal Government and include Federal Forest Reserve and Payment in Lieu of Taxes.[58] Indirect revenues are the transient occupancy taxes collected as a direct result of visitors to the national forest buying and paying sales tax and staying transient occupancy taxes. Secondary revenues are those taxes collected because those businesses providing these services use a portion of the revenues received to pay their taxes. Management decisions that affect these activities have the potential to impact these revenues. To determine the context of these payments, it is necessary to understand how important these revenues are to local budgets and also understand the current overall budget conditions of local governments. Communities facing difficult fiscal conditions would feel an impact from changes in these revenues, thus leading to the potential for reduced public services provision in the area.

The context of these three factors is examined below. This information is obtained from "Chapter 6: Assessing Social, Cultural and Economic Conditions" of the individual national forest assessments that were written for plan revision (USDA Forest Service 2013a).

Economic Health

With high unemployment, lower earnings and lower per capita income than California and similar to Nevada as a whole, the counties in the study area for the Inyo National Forest are facing challenges to their economic health. Thus, these communities are less able to adapt to forest

[58] Without Congressional reauthorization of the Secure Rural Schools and Community Self Determination Act, the Forest Service must revert to making payments to States under the 1908 Act, commonly called the 25% payments, for the 2017 payment year and beyond.

management changes that would affect key economic sectors. This data from the national forest assessments (USDA Forest Service 2013a) is presented in table 111.

Table 111. Economic health surrounding the Inyo National Forest

Key Economic Measures	Inyo National Forest	Bioregion	California	Nevada
Unemployment rate, 2011 (percentage)	10.3	14.3	11.7	13.5
Average earnings, 2011 (dollars)	42,935	51,744	60,453	48,606
Per capita income, 2011 (dollars)	39,737	36,127	43,856	38,104

The bioregion is meant to represent communities in and around the national forests in the region. It is comprised of the counties that intersect the area examined in the "Final Sierra-Nevada Bioregional Assessment" (USDA Forest Service 2013d)

Economic Diversity

Studies conducted for the area surrounding the Inyo National Forest have demonstrated that local economies are very dependent on tourism and recreational activities and any changes in the level of these activities would be expected to have an effect on the economy (Alkire 2012, Guilliams and Clines 2012, Gruen Gruen and Associates 2010). In addition, a recent report examining the history and potential of economic opportunities in Mono and Inyo Counties reinforces this finding, stating that, "neither county has demonstrated extensive economic diversification beyond the government and hospitality/leisure sectors" (Sierra Business Council 2012). As a result, the economies of all of these California and Nevada counties are likely susceptible to effects from changes in national forest management that lead to changes in visitation to the area.

Local Fiscal Conditions

The counties around the Inyo National Forest receive important revenues from sales taxes on temporary lodging from visitors to the region. Available data shows that these sources are a significant portion of the tax revenue collected in both Mono (4.6 percent of total revenues) and Inyo (4.3 percent) Counties (California State Controller's Office 2012). One study estimated the percentage of the county sales tax revenue that was visitor related. This includes spending on goods and services while visiting an area, and this visitor spending is again identified as important to fiscal consideration for Mono (57.9 percent) and Inyo (20.8 percent) Counties (Dean Runyan and Associates 2012). Given the similar rural nature and historical ties to the national forest, fiscal contributions from visitation and national forest activities are also important in Esmerelda and Mineral Counties. Therefore, it is important to recognize that these smaller rural counties are reliant on visitors to the Inyo National Forest to contribute tax revenues essential for providing key public services.

Payments in lieu of taxes (PILT) and other federal payments (such as the 25 Percent Fund and Secure Rural Schools Act payments) are also an important contribution to local county government revenue. This funding source is especially important locally in Inyo County where less than 2 percent of the land in the county is privately owned (USDA Forest Service 2015b). The counties also receive tax revenues from the 348 recreational residences located on Inyo National Forest. The majorities of these residences (282) are in the Mono Lake, Mammoth and White Mountain Ranger Districts and pay taxes to support services in Mono County. These residents pay taxes but only use the resulting county services for a portion of the year.

Key National Forest Economic Contributions

Contributing to community well-being by providing a broad range of economic opportunities for national forest communities is consistent with current Forest Service direction from the U.S. Department of Agriculture to generate jobs through recreation and natural resource conservation, restoration, and management in rural areas (USDA Forest Service 2015d). However, Federal forest management alone cannot ensure community stability because jobs in the forest products, agricultural, mining, and recreation industries are influenced by market conditions and changes in technology outside the control of forest management. As a result, national forests cannot expect to ensure community economic wellbeing through their management actions alone (Charnley 2013).

While national forests are not the sole factor determining economic wellbeing, they do contribute economically to local communities and also to communities that are located further from the national forest. Recreational opportunities on the Inyo that draw visitors to the area are specifically important to local economies within the study area. Grazing and mining activities also occur on the Inyo and are important to local economies and culture. However, there are no current or expected future changes to mining activities or the associated program as a result of the proposed plan alternatives, so mining is not examined in detail here. Water from the national forest is also examined as a vital resource with economic value both on and off the Inyo that is influenced by national forest management.

Other vital national forest benefits besides these commodities may be less apparent in our daily lives and their benefits difficult to measure, but these benefits are important because they support the ecosystems and social environments in which we live (such as, biodiversity of forest landscapes). However, there is no universally accepted methodology for how to quantify the benefits of these types of non-market benefits. Instead, the benefits provided by biodiversity are described qualitatively to capture the importance of these benefits to people.

Recreation and Tourism

In 2010, travel- and tourism-related industries were important in local communities supporting 50 percent of the jobs in the counties bordering the Inyo National Forest. This percentage is much greater than for other national forests in the bioregion (supporting 18.1 percent of jobs in bordering counties) and the state as a whole (15.7 percent). The numbers of travel- and tourism-related jobs in these counties have been relatively stable from 1998 through 2010. Average annual wages in these jobs are below the average wage for all private sector jobs, so these are relatively lower paying jobs in local communities (Headwaters Economics 2012). The landscapes in this area provide valuable and unique recreational opportunities. The natural amenities provided by wilderness on the Inyo National Forest also contribute value to communities through visitor spending, attracting potential economic development opportunities and contributing to increasing property values (Holmes et al. 2015). Also, the contributions of volunteers are an important economic consideration of recreational activities. Many of the national forest volunteers are drawn to the area for the recreational opportunities and contribute their time and energy to maintain the quality of that experience.

A study examining the value of travel and tourism estimated the percentage of total county employment and earnings generated by all travel in California. Travel and tourism around the Inyo National Forest generates 48.6 percent of employment and 32.2 percent of earnings in Mono County and 23.5 percent of employment and 11.5 percent of earnings in Inyo County (Dean Runyan and Associates 2012). Contributions in Nevada counties would also be expected to be important to the communities in those areas.

Grazing

Pasture and rangelands within the counties bordering Inyo National Forest comprise around 70 percent of the total of all land area in farms, which is greater than the percentage for the bio-region as a whole (53.0 percent). In terms of number of farming operations, cattle, sheep and goat farming, which are the primary types of animals that are grazed on public lands, account for around 43 percent of all operations, again more than the bio-region (22.5 percent; USDA Forest Service 2013a).

In addition, summer forage on the Inyo is critical to the economic viability of local ranches. If these ranchers did not have summer grazing permits on the Inyo National Forest, then their businesses may no longer be economically viable. These ranches have an impact on the local economy through an economic multiplier effect from the activity on these ranches requiring employees, materials and services from other businesses in local communities.

Commodity-based Estimates of Economic Contributions

Estimates of the jobs, compensation, and tax contributions of activities derived from the economic contribution models for Inyo National Forest are provided in table 112 (USDA Forest Service 2015f). These values should be used to gain an understanding of the relative context of national forest contributions and not as exact measures of these contributions. Therefore, all estimates are rounded to the nearest 100. Employment, expressed as jobs supported, represents the average annual employment and includes a combination of full and part time, temporary, and seasonal workers in Inyo and Mono counties in California and Esmerelda and Mineral Counties in Nevada.

Table 112. Estimates of the economic contributions, 2012

Employment (Jobs)	State and Local Government Total Tax Impact (M$)	Federal Total Tax Impact (M$)
2,900	$17,200	$16,200

Given data limitations, state and local government total tax impact does not include tax contributions from grazing; source: USDA Forest Service 2014f

The sectors with the most jobs supported by national forest contributions are: government; agriculture; retail trade; accommodations; food services; arts and entertainment; and recreation. These findings highlight the Inyo National Forest’s key contributions to local economies, primarily for the visitors it draws to the area.

The Importance of Water to Economic Sectors

Water originating on the Inyo National Forest supplies clean water for 3.8 million people and electricity for millions more in local towns and communities as far-ranging as Los Angeles and Fresno. Supplying this water for communities is estimated to provide upwards of approximately 300 jobs to the local Inyo County economy (Richards 2015a). In addition, the water from the Inyo National Forest and adjacent lands is used extensively for recreational activities such as fishing, boating, and swimming, and aesthetic enjoyment. These recreational activities are vital to supporting the local economy in both Mono and Inyo counties.

Wildfires affect these important water resources by removing vegetation and altering soils and ground cover, with the magnitude of post-wildfire impacts being dependent on burn severity.

These changes have large implications to water resources through their effects on transpiration rates, water infiltration rates, the rates and magnitudes of erosion, peak and base streamflows, and total water yield (California Department of Water Resources 2016). Therefore, forest management plays a large role by influencing the economic value of water from Inyo National Forest.

Biomass Utilization for Energy

The wave of biomass utilization has rose and subsided in the past, and may be on the rise again with the level of mortality experienced in California in recent years. National Forest System lands can be an important source of fuel for biomass facilities if in proximity. Biomass utilization can be an important tool for reducing project-generated fuels, but on the Inyo National Forest, to date such infrastructure is lacking in the local region. Given expected volumes, biomass generated on the Inyo would need to be supplemented by fuels from other sources in order to make biomass energy sustainable.

Biodiversity

The changing elevation across the Inyo National Forest combined with the variability in aspect and slope, the variety of geology and soils, and the amount and timing of precipitation, creates an extremely high diversity of ecosystems. These varied ecosystems across the Inyo are inhabited by a diversity of wildlife including 300 wildlife species and more than 1,300 plant species (see "Wildlife, Fish, and Plants" section). As a result, fishing, wildlife hunting, and wildlife viewing are important benefits provided to the public by the national forest. The Inyo's terrestrial and aquatic plant and animal species are dependent on resilient, diverse ecosystems that also sustain a social and economic fabric connected to a healthy forest. Sustaining these plant and animal species contribute to local communities by providing a quality environment where visitors can enjoy these landscapes. In addition, the diversity of the plant community supports a wide range of important economic and social beneficial uses such as food (such as mushrooms, fruits, and ferns), medicines, floral greens, seeds and cones, and transplants.

Important Inyo National Forest Benefits to Inyo County

The communities of Inyo County have typically relied upon activities on public lands, and the Inyo National Forest in particular, for their well-being. The county's economy historically developed based on resource extraction and agriculture, which has since transitioned toward a service economy tied to tourist-oriented recreation on the Inyo National Forest. This history has shaped the society and culture of the county. In addition, more than 98 percent of Inyo County is managed by government agencies,[59] and therefore decisions on the use of these lands have a large influence on the economy of the county. Given these critical economic and social ties between the Inyo National Forest and Inyo County, an important part of understanding the affected environment is identifying the key locations and activities on the Inyo National Forest and how they contribute to Inyo County.

Visitation and tourism resulting from recreational activities in the Inyo National Forest is a major contributor to the local Inyo County economy. As shown in table 112, national forest contributions are important to the counties surrounding the Inyo National Forest. Contributions to the recreation- and service-based sectors comprise the majority of this activity. While the Forest

[59] Inyo National Forest, Death Valley National Park, China Lake Naval Weapons Center, and Bureau of Land Management holdings total approximately 92 percent; the City of Los Angeles, as part of the Owens Valley aqueduct and associated lands, owns nearly 4 percent; and the State of California controls nearly 2.5 percent.

Service Economic Contributions model is not able to break out these estimated totals by county, other available data can help to illustrate the degree to which Inyo County relies on these national forest contributions. Inyo County estimates that wilderness activities generate approximately $4.5 million in visitor spending there annually. Fishing and hunting provide additional visitor spending estimated as $2.7 million and $544,000, respectively.[60] Off-highway vehicle users spend about $305,000 annually. Grazing on Inyo National Forest System lands in the county are estimated as providing $5 million in revenues (Richards 2015a, Inyo County 2015). Finally, the potential for future mining is also an important economic consideration because of the potential for jobs and incomes in the county (Richards 2015b). Therefore, management decisions that affect visitation, mining, and grazing would have economic consequences for Inyo County communities.

Working in collaboration with the county, key forest locations and activities for socioeconomics were identified; these are presented in table 4 and figures 1 and 2 of the Economics Supplemental Report. These key activities focus on recreation, mining, and agriculture (grazing). Actions associated with plan revision and future national forest projects that would have implications on these important national forest contributions should be evaluated as to the significance of such effects.

Environmental Consequences to Economic Conditions

Financial Examination

National forest project-level planning and implementation is guided by the budget as received from Congress and passed down through the Department of Agriculture to the Forest Service and then to the national forest. Therefore, to reflect this budget reality, the analysis assumes continuation of the trend of recent national forest budget obligations. Given this assumption, this section examines the potential funding opportunities and challenges of funding outside of the appropriated national forest budget that would be expected to be available to achieve the increase in pace and scale of activities.

Consequences Common to Alternatives B, B-modified, C, and D

There are challenges to project funding that is outside of the forest plan and the plan revision process. Increases in the pace and scale of restoration would involve increases in the costs associated with project preparation and project planning. Alternatives B, B-modified, C, and D would need to identify efficiencies for these planning processes in order to reduce the increased costs associated with additional project planning and preparation. Given current budget trends, identifying and implementing these efficiencies will be critical to the success of any alternative that is chosen.

Potential increases in national forest revenues provide new opportunities for additional project funding resources. National forest revenues potentially affected by the proposed plan alternatives are associated with activities occurring in the recreation program and the forest product program. Recreation staff members do not foresee significant changes in the revenues that would be generated by the recreation program on the national forest as a result of alternatives B, B-modified, C, or D. Therefore, new funding opportunities resulting from changes in recreation revenues are expected to be limited and to be similar across all the alternatives. Forest product

[60] This estimate is a lower bond calculated using hunting and fishing licenses that were purchased in Inyo County. Visitors who purchase licenses in other counties also visit the forest for these activities and would also contribute to the local economies.

activities on the Inyo National Forest are limited and therefore forest product value is not likely to be a significant funding source for restoration activities under any of the alternatives.

An important option will be establishing funding opportunities and partnerships with Federal, State, and local agencies as well as capable stakeholder groups. All plan revision alternatives highlight working collaboratively with stakeholders to develop these types of funding opportunities. Successful implementation would require national forest project goals to align with the goals for outside agencies and stakeholder groups willing to partner to fund restoration activities. Examples of these types of opportunities include cost-share agreements, memorandums of understanding, and stewardship agreements with partners taking on active management roles that allow the Forest Service to leverage resources and staff from other organizations to conduct or assist in treatments on and adjacent to national forest lands. Developing these types of opportunities requires the additional cost of time and resources associated with engaging potential partners and establishing agreements.

Forest Benefits Examination

Wildfire, disease, and insect pathogen mortality in vegetation is increasing in severity across the bioregion, and a high percentage of the landscape that provides the key national forest benefits outlined previously are under threat (Metcalfe et al. 2013). As a result of these threats, there is great potential for disruption in the underlying ecological processes and for resulting loss and interruption in forest benefits. This loss of benefits has a cost to the local communities in California and Nevada and to the region as a whole. Examples of more localized costs include the loss of recreational opportunities for visitors, reductions in local employment and tax revenues from national forest commodities such as grazing, and the effects on the economies of local communities through reduced tourism in the area. When other important benefits such as water supply, electricity generation, and biodiversity are lost, the potential effect moves beyond the local area to people across the state who are affected by the loss of these services even if they do not live near the national forest nor ever plan to visit there.

The potential indirect effects of plan alternatives on these important forest benefits to people are examined as follows, first highlighting the similarities between the plan alternatives B, B-modified, C, and D, and then highlighting their key differences. Important to this analysis is capturing the effects of plan alternatives on the economic health, diversity, and fiscal conditions that are outlined in the affected environment section above. Therefore, a local communities section highlighting these potential effects for the local communities in California and Nevada is included in each alternative description. The description of effects below is a summary of findings and a more detailed description of potential effects on national forest benefits are provided in the Economics supplemental report.

Consequences Common to Alternatives B-modified, B, C, and D

There are three important potential effects that are relevant to all of the plan revision plan revision alternatives. These common effects result from the increased pace and scale of restoration that is called for in all of these alternatives.

First, alternatives B, B-modified, C, and D increase restoration activities in total (through more focus on mechanical thinning in alternatives B, B-modified, and D and through more focus on use of prescribed fire and managed fire in alternative C). Therefore, all of the plan revision alternatives provide greater potential to improve the long-term sustainability of key national forest benefits and contributions when compared to alternative A, which maintains current restoration activity levels.

Second, alternatives B, B-modified, C, and D also have the potential for adverse short-term effects. These effects result from increased restoration activity that can temporarily interrupt these same national forest benefits and contributions.

Third, the increased pace and scale of restoration in alternatives B, B-modified, C and D supports jobs. Contractors from local communities are often hired to perform these restoration activities and this is important since employment opportunities in these areas are often limited. The Pacific Southwest Region has been working to improve processes to allow for more businesses in these local communities to obtain contracts for work and benefit from restoration activities. A study examining forest and watershed restoration work found that approximately 16 to 24 jobs are supported for each $1 million that is invested in restoration activities (Nielsen-Pincus 2010). This range is dependent on the type of activities that are performed in restoration. Investments in labor-intensive activities (such as site preparation, tree and shrub planting, and cutting small trees and brush by hand) support the greater number of jobs, whereas equipment- and technical-intensive activities (such as forest thinning, small-diameter and selective logging, masticating ground fuels, constructing stream habitat features and excavating of floodplain and wetland features) support fewer jobs.

Increased pace and scale of restoration also leads to employment and economic activity in a variety of other economic sectors throughout the economy beyond the effects of employment generated by the activities themselves. These multiplier effects arise from materials and equipment being purchased from suppliers as well as restoration workers spending their paychecks for goods and services. The top two economic sectors typically affected by this multiplier effect are wholesale and retail trade, including transactions for fuel, wood products, rock, metal, and other building and landscaping products. Other common but less affected sectors include employment services, commercial and industrial machinery rental, commercial and industrial machinery repair and maintenance, and professional services (such as insurance brokers and accountants; Nielsen-Pincus 2010).

Table 113. Summary of short-term and long-term potential effects on key national forest benefits by alternative

National Forest Contribution	Alternative A short-term / long-term effects	Alt B-modified short-term / long-term effects	Alternative B short-term / long-term effects	Alternative C short-term / long-term effects	Alternative D short-term / long-term effects
Water	adverse/ adverse	uncertain/ beneficial	uncertain/ beneficial	uncertain/ beneficial	uncertain/ beneficial
Sustainable recreation	adverse/ adverse	uncertain/ beneficial	uncertain/ beneficial	uncertain/ beneficial	uncertain/ beneficial
Air quality	adverse/ adverse	uncertain/ beneficial	uncertain/ beneficial	uncertain/ beneficial	uncertain/ beneficial
Energy generation	adverse/ adverse	beneficial/ beneficial	beneficial/ beneficial	uncertain/ uncertain	beneficial/ beneficial
Grazing	none/ adverse	adverse/ uncertain	adverse/ uncertain	uncertain/ uncertain	adverse/ beneficial
Biodiversity	none/ adverse	adverse/ beneficial	adverse/ beneficial	adverse/ beneficial	adverse/ beneficial

There are some important differences between alternatives B, B-modified, C, and D. These differences arise primarily from differences in the intensity and the approach to restoration under each alternative and are described below. A summary of the potential short- and long-term effects on six key national forest benefits is provided in table 113 (water quality and quantity, recreation, air quality, grazing, energy generation, and biodiversity).

Consequences Specific to Alternative A

Under the current forest plan, trends in current resource conditions are expected to continue, and therefore the long-term sustainability of all six key national forest benefits provided by these resources to people locally and across the region is threatened. Particularly important are the threats of uncharacteristic wildfire, disease, and insect mortality of forest vegetation that contribute to declining forest health and increase interruptions both in the short term and long term for all of these national forest benefits.

Potential Implications for Local Communities in California and Nevada

Under the current forest plan, the resulting decline in the long-term sustainability of all six key national forest benefits would result in significant adverse economic effects for local communities. These effects would be felt most directly through the potential loss of recreational visitation as a result of declining quality of recreational settings and increasing limits on opportunities from wildfire closures. Declining trends in species biodiversity would also adversely affect national forest visitation for important activities such as hunting, fishing, plant gathering, and wildlife watching. Rural communities located along access routes to the national forest often have a strong tie to the economic contributions that recreational visitors provide. This includes the visitor spending that supports jobs and also the contributions to local tax revenues through the sales and lodging taxes collected. These local tax revenues support important public services that improve the quality of life in these communities. The connection between recreational visitation and local economies is especially true for the Inyo National Forest and the critical importance of recreational-based, service-oriented businesses located within Inyo County. Maintaining the current plan direction would not contribute to improving the sustainability of this important recreational visitation.

Increases in the smoke from wildfires also contribute to this potential adverse economic effect resulting from decreasing recreational visitation. Under the current forest plan, trends for more and larger wildfires would be expected to continue, thus increasing the likelihood that visitors even far from the fire area would stay away due to smoke during at least some portion of the fire season, which is expected to be starting earlier and lasting later into the year. In addition, this smoke from wildfires adds to air pollution and adversely affects the health of residents in local communities. Alternative A does not contribute to improving the sustainability of air quality benefits to people and communities.

The important local economic benefits provided by water would also decline under alternative A. The water used downstream from Inyo National Forest is valuable for municipal and agricultural uses. It is also valuable for recreational and ecological uses on the national forest because this water sustains the important water-based recreational setting and forest biodiversity that draws visitors. Given expected restoration levels in alternative A, the quantity and quality of water would be expected to continue current trends in declining stream flows and increasing temperatures, thus reducing and interrupting the benefits this water provides. As a result, there would be expected costs to users from reduced local recreational opportunities, reduced water use and the need to utilize higher cost alternative water supplies.

Grazing opportunity would potentially be adversely affected as a result of no increase in restoration activities to reduce the risk of uncharacteristic wildfire and to improve forest health. These types of events increase the potential for future interruptions to grazing opportunities. Therefore, there are potential adverse long-term effects on the local communities that are dependent on forest grazing.

Biomass provides the opportunity to generate electricity for the region and also support local job opportunities in biomass harvesting. The current forest plan does not have the potential to provide any additional biomass to support development of industry infrastructure. The current plan also does not help to create an environment with a reliable supply of biomass that would be more favorable to investment in such new biomass facilities. The current forest plan does not contribute to improving the sustainability of benefits from energy generation from biomass.

Consequences Specific to Alternatives B-modified and B

The restoration activities in B-modified and B, would be expected to help reverse current trends and to improve the long-term sustainability of five of the six key national forest benefits that provide benefits to people locally and across the region. Long-term effects on grazing are uncertain. Grazing would benefit in the long-term from restoration but also could be adversely affected by restrictions in the areas recommended for wilderness. In the short term, the potential effects would be mixed across the different national forest benefits. These effects would be adverse for biodiversity and grazing from increases in disturbances related to the increasing of restoration activities. The effects would be mixed for water, recreation and air quality. Water quality may be impacted from the potential for increased sedimentation from additional restoration activities. Recreation would benefit in the short term from reduced wildfire, but it would be adversely affected by the potential for some restrictions on activities as a result of restoration projects. The new recreational zones developed in alternatives B-modified and B are not expected to result in any changes to the number of visitors or types of recreational activities occurring on the Inyo. Air quality also would benefit in the short term from reduced wildfire, but the use of prescribed fire under alternatives B-modified and B would create the potential for some short-term decreases in air quality as a result of these activities. Energy generation potentially would benefit in the short term from increased restoration activities that: (1) yield increased biomass to support potential development of infrastructure in the area, and (2) support the potential for more water quantity for electricity generation.

Potential Implications for Local Communities in California and Nevada

The restoration activities in alternatives B-modified and B would be expected to improve the long-term sustainability of all six key national forest benefits and result in significant beneficial economic effects for local communities when compared to alternative A, the current forest plan. These effects would be felt most directly through the potential gain in the long-term sustainability of recreational visitation as a result of maintaining the quality of recreational settings and the opportunities of visitors. Maintaining species biodiversity would also contribute to sustaining national forest visitation for important social and economic activities such as hunting, fishing, plant gathering, and wildlife watching. Alternatives B-modified and B contribute to improving the long-term sustainability for all of this recreational visitation.

Given the increases in restoration activities, alternatives B-modified and B have the potential to result in adverse short-term effects through closures of recreational areas during restoration project activities and disturbances to species diversity. This potential adverse effect is expected to be minor and is off-set by the potential for reduced wildfire when compared to the current forest plan, and therefore fewer related closures of recreational areas during fires and fewer adverse wildfire effects on species would be expected to occur. The overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on recreation. The new recreational zones and winter recreation opportunity spectrum settings developed in alternative B-modified are not expected to result in any changes to the number of visitors or types of recreational activities occurring on Inyo National Forest. Wilderness recommendation, and any subsequent wilderness designation, would restrict mountain biking. Current mountain-biking use in these areas is limited given the topography, vegetation and sandy soil. In addition, other local alternative mountain biking opportunities exist, so any potential effects to mountain biking are expected to be minimal. The direction in aquatic strategy and the introduction of conservation watersheds in alternative B-modified are not expected to have any effect as the plan components do not hinder, prohibit, or restrict activities within these areas. Therefore, any potential adverse economic effects to communities are expected to be negligible.

Reductions in the smoke from potential future wildfires also contribute to this potential beneficial economic effect resulting from sustaining recreational visitation. Under alternatives B-modified and B, restoration activities would potentially result in fewer larger wildfires in the long term, thus reducing the likelihood that visitors stay away from the area. In addition, the long-term reduction in smoke from wildfires would help to improve air quality and the health of residents in local communities. There would be some use of prescribed fire under alternatives B-modified and B that could lead to reduced air quality and reduced recreational access in the short term. This use of prescribed fire would be planned to occur under favorable conditions to mitigate potential adverse effects. Still, the overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis should be conducted to better understand the trade-offs to communities from these potential project economic effects on air quality.

Alternatives B-modified and B would contribute to sustaining the important local economic benefits provided by water from the Inyo. The water that is used downstream from the Inyo is valuable for municipal and agricultural uses, and also for recreational and ecological uses on the national forest because this water sustains the important water-based recreational setting and biodiversity that draws visitors. The quantity and quality of this water would be expected to improve in the long term under alternatives B-modified and B as compared to the current forest plan, as current trends in decreasing stream flows and higher temperatures could be tempered. In the short term, there would be the potential for adverse effects from increased sedimentation as a result of increased restoration activities. This could potentially have adverse short-term economic consequences on recreational visitation, and increase the downstream costs of using water from the national forest.

Grazing opportunity would benefit in the long term from the increase in restoration activities that would reduce the risk of uncharacteristic wildfire and improve forest health. Wilderness designation of those areas recommended under these alternatives would not restrict current permitted grazing levels. However, wilderness designation would prohibit access by motorized vehicle for maintenance of stock water developments, salt placement and restrict installation of new range improvements (such as water troughs) unless approved following a minimum requirements decision. Overall, the annual operating costs to the current permittees would be expected to increase under these conditions. Given the acreages identified for recommendation in each alternative, the adverse effects of alternatives B-modified and B would be less than under alternative C (if designated by Congress), which recommends the most wilderness. The extent of these effects is uncertain at this programmatic level.

There would be some short-term potential for disruption to grazing opportunity due to increased restoration project activity in and around allotment areas. This short-term disruption is expected to be minimal. Conservation watershed plan components do not directly prohibit livestock grazing activities or restrict or limit this use. Plan components for these management areas allow for the continued use of livestock and do not prescribe additional standards that should increase hardship or burden on livestock operations, including the variety of management options available to livestock grazing operations. Overall, there are potential adverse short-term and uncertain long-term effects on the local communities that are dependent on forest grazing.

Biomass provides the opportunity to generate electricity for the region and also support local job opportunities in harvesting. Alternatives B-modified and B provide the potential to contribute additional biomass to support developing an industry workforce and also creating a more favorable environment with a reliable biomass supply to support the investment in biomass facilities. This investment would be required in the long term to increase the pace and scale of restoration. The restoration activities proposed under alternatives B-modified and B also contribute to reducing adverse effects associated with the quantity and timing of water, and as a result improve the economic benefits from electricity generation through hydropower as compared to alternative A, the current forest plan.

Consequences Specific to Alternative C

The restoration activities proposed in alternative C focusing on managed fire and use of prescribed fire would be expected to help reverse current trends and to improve the long-term sustainability of four of the six key national forest benefits (water, recreation, air quality, grazing and biodiversity) that provide benefits to people locally and across the region. The long-term sustainability of grazing is uncertain (similar to alternatives B and B-modified) and the long-term effects for energy generation from biomass would be adversely affected and would be similar to long-term effects identified under alternative A, the current forest plan.

In the short term, the potential effects are mixed across the different national forest benefits. These effects would be adverse for biodiversity from increases in disturbances related to the increasing of restoration activities. The short-term effects are mixed for water, recreation, energy generation, grazing, and air quality. Water quality could potentially be adversely affected from the potential for increased sedimentation from restoration activities. Recreation benefits in the short term from reduced wildfire, but is adversely affected by the potential for some restrictions on activities as a result of restoration projects. The overall effect on energy generation is uncertain because, while there would be reduced biomass utilization for energy generation, there is also the potential for improvements in water quantity and timing that could improve hydropower generation. Grazing would potentially be limited in the short-term by project activity but would also benefit from fire based restoration activities that could improve grazing settings. Air quality benefits in the long term from reduced wildfire, but effects are uncertain in the short term as a result of the amount of use of prescribed fire that is emphasized under alternative C and the fact that this burning would be used under favorable atmospheric conditions and thus effects could be mitigated.

Potential Implications for Local Communities in California and Nevada

The restoration activities in alternative C focusing on managed fire and use of prescribed fire would be expected to improve the long-term sustainability of four of the six key national forest benefits and result in significant beneficial economic effects for local communities. These effects would be felt most directly through the potential gain in the sustainability of recreational visitation as a result of maintaining the quality of recreational settings and the opportunities of visitors. Maintaining species biodiversity would also contribute to sustaining national forest visitation for important social and economic activities such as hunting, fishing, plant gathering, and wildlife watching. Alternative C contributes to improving the long-term sustainability for all of this recreational visitation.

The additional areas identified in alternative C as potentially suitable for recommended wilderness would potentially result in economic effects for local communities within Inyo County. Specifically important are current and historic grazing areas on the east side of Monache Meadow. Potential effects on grazing in this area could impact communities because of increases in expenses for ranchers as well as increased difficulty transporting cattle to the area and maintaining infrastructure. There are also some active small-scale mining activities and mining claims in the areas of Redding Canyon, Marble Canyon and the Montezuma Mine. Even though these activities are currently limited, potential losses or restrictions to current and future mining opportunities would have potential effects for local communities.

Given the use of prescribed fire and managed fire restoration activities, alternative C has the potential to result in adverse short-term effects through closures during restoration project activities and disturbances to species diversity. This short-term disturbance would be expected to be similar to alternatives B and B-modified, and less than alternative D. This potential adverse effect is off-set by the potential for reduced wildfire, and therefore fewer related closures of recreational areas and fewer adverse wildfire effects on species. The overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on recreation.

Alternative C emphasizes investment in dispersed recreational opportunities over developed opportunities. The types of goods and services needed by visitors to dispersed areas and the resulting spending of these visitors are different than for developed areas. Therefore, emphasis on projects that could lead to a long-term shift in the type of visitor to the national forest would be examined at the project level to determine potential economic impacts on local communities as well as on other resources.

Reductions in the smoke from wildfires also contribute to potential beneficial economic effects resulting from improved sustainability of recreational visitation. Under alternative C, restoration activities would result in fewer larger wildfires in the upper montane areas treated with managed fire and use of prescribed fire, thus reducing the likelihood that visitors stay away from these areas. In addition, the reduced smoke from wildfires would help to improve air quality and the health of residents in local communities. There would be an emphasis on the use of prescribed fire and wildfire managed to meet resource objectives under alternative C that could lead to reduced air quality and recreational access in the short term. These activities would be planned to occur under favorable conditions in order to mitigate potential adverse effects. Still, the overall effect given the dependence of alternative C on fire for restoration is for some short-term adverse effects on air quality that would have effects on human health, recreational visitation, and economic conditions in local communities.

Alternative C would contribute to sustaining the important local economic benefits provided by water from the national forest. The water that is used downstream from the Inyo is valuable for municipal and agricultural uses and is also valuable for recreational and ecological uses on the national forest because this water sustains the important water-based recreational setting and biodiversity that draws visitors. The quantity and quality of this water would be expected to improve in the long term under alternative C as compared to the current forest plan, given restoration activities that would reverse declining stream flows and increasing temperatures. In the short term, there would be the potential for adverse effects from increased sedimentation as a result of increased restoration activities; this sedimentation would be similar to alternatives B and B-modified, and less than alternative D. This could potentially have adverse short-term economic consequences on recreational visitation, and increase downstream costs of using water from the Inyo National Forest.

Grazing opportunity would benefit in the long-term from the increase in restoration activities to reduce the risk of uncharacteristic wildfire and improve forest health. Wilderness designation of those areas recommended under the alternative would not restrict current permitted grazing levels. However, wilderness designation would prohibit access by motorized vehicle for maintenance of stock water developments, salt placement and restrict installation of new range improvements (such as water troughs) unless approved following a minimum requirements decision. Overall, the annual operating costs to the current permittees would be expected to increase under these conditions. Given the acreages identified for recommendation in each alternative, the adverse effects under alternative C, if designated by Congress, would be greater than alternatives B and B-modified. The extent of these effects is uncertain at this programmatic level.

There would be some short-term potential for disruption to grazing opportunity due to increased restoration activity in and around allotment areas. This short-term disruption is expected to be minimal. There is also the potential for a short-term benefit from increased restoration using prescribed and managed fire as a primary restoration tool. These restoration activities would reduce woody biomass and increase herbaceous plants in large areas of the national forest thus having the potential to improve grazing settings. Overall, there are uncertain short- and long-term effects on the local communities that are dependent on forest grazing as there is the potential for both adverse and beneficial effects.

Biomass provides the opportunity to generate electricity for the region and also supports local job opportunities in harvesting. However, the focus on fire for restoration and the lack of higher value timber harvests to subsidize biomass removal does not result in expected development of biomass opportunities for energy generation. Long-term local job creation from hydropower generation is less than it is from biomass energy given there is no need for continual harvesting and processing of materials. Restoration activities proposed under alternative C contribute to reducing adverse effects associated with the quantity and timing of water, and as a result improve the long-term local economic benefits from electricity generation through hydropower as compared to alternative A, the current forest plan.

Consequences Specific to Alternative D

The restoration activities in alternative D would be expected to help reverse current trends and improve the long-term sustainability of all six key national forest benefits that provide benefits to people locally and across the region. These effects would be similar to the effects outlined in alternatives B and B-modified. Key differences with alternatives B and B-modified would be that the increased pace and scale of restoration in alternative D would be expected to provide greater potential benefits to the long-term sustainability of these six national forest benefits, but also lead to potential increases in adverse short-term effects resulting from increased restoration activities.

Potential Implications for Local Communities in California and Nevada

The restoration activities in alternative D would be expected to improve the long-term sustainability of all six key national forest benefits and result in significant beneficial economic effects for local communities. These effects would be felt most directly through the potential gain in the sustainability of recreational visitation as a result of maintaining the quality of recreational settings and the opportunities of visitors. Maintaining species biodiversity would also contribute to sustaining national forest visitation for important social and economic activities such as hunting, fishing, plant gathering, and wildlife watching. Alternative D contributes to improving the long-term sustainability of this recreational visitation.

Given the increases in restoration activities, alternative D does have the potential to result in adverse short-term effects through closures during restoration project activities and disturbances to species diversity. This short-term disturbance would be expected to be larger than in alternatives B and B-modified. This potential greater adverse effect is off-set by the greater potential for reduced wildfire, and therefore fewer related closures of recreational areas and fewer adverse wildfire effects on species. The overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under alternative D. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on recreation.

Alternative D emphasizes investment in developed recreational opportunities over dispersed opportunities. The types of goods and services needed for developed activities and the spending patterns of these visitors are different than they are for dispersed visitors. Therefore, emphasis on projects that could lead to a long-term shift in the type of visitor to the Inyo National Forest should be examined at the project level to determine potential economic impacts on local communities as well as on other resources.

Reductions in the smoke from wildfires also contribute to potential beneficial economic effect resulting from sustaining recreational visitation. Under alternative D, restoration activities would potentially result in fewer larger wildfires, thus reducing the likelihood that visitors stay away from the area. In addition, the reduced smoke from wildfires would help to improve air quality and the health of residents in local communities. There would be some use of prescribed fire under alternative D that could lead to reduced air quality and recreational access, but increased mechanical thinning before burning would help to limit this potential effect. In addition, this use of prescribed fire would be planned to occur under favorable conditions in order to mitigate potential adverse air quality effects. Still, the overall effect of these two opposing factors is uncertain and is dependent on the specifics of the projects developed under this alternative. Project-level environmental analysis would be conducted to better understand the trade-offs to communities from these potential project economic effects on air quality.

Alternative D would contribute to sustaining the important local economic benefits provided by water from Inyo National Forest. The water that is used downstream from the Inyo is valuable for municipal and agricultural uses. It is also valuable for recreational and ecological uses on the national forest because this water sustains the important water-based recreational setting and biodiversity that draws visitors. The quantity and quality of this water would be expected to improve in the long term under alternative D as compared to alternative A, the current forest plan. In the short term, there would be the potential for adverse effects from increased sedimentation as a result of increased restoration activities and this sedimentation would be greater than under alternatives B and B-modified. This could potentially have adverse short-term economic consequences on recreational visitation as well as on the downstream costs of using water from the national forest.

Grazing opportunity would benefit in the long-term from increases in restoration activities to reduce the risk of uncharacteristic wildfire and improve forest health. There would be some short-term potential for disruption to grazing opportunity due to increased restoration project activity in and around allotment areas. This short-term disruption is expected to be minimal. Overall, there is potential adverse short-term and beneficial long-term effects on the local communities that are dependent on forest grazing.

Biomass provides the opportunity to generate electricity for the region and also supports local job opportunities in harvesting. Alternative D provides the potential to contribute additional biomass to support developing an industry workforce and also support investing in new biomass facilities. This investment would be required in the long term if the State is to establish a market for biomass, which would be necessary in order to increase the pace and scale of restoration. Long-term local job creation from hydropower generation is less than it is from biomass energy, given there is no need for continual harvesting and processing of materials. Restoration activities proposed under alternative D contribute to reducing adverse effects associated with the quantity and timing of water and as a result, improve the economic benefits from electricity generation through hydropower as compared to alternative A, the current forest plan.

Cumulative Effects

The Inyo National Forest represents only a portion of the landscape that comprises the natural landscape in this area. The resources throughout this entire region provide economic contributions to local communities and regional benefits that improve the quality of people's lives.

Forest restoration projects developed under the revised plan could potentially have short-term effects on forest benefits resulting from disruptive project activities (such as area closures and resource disturbance). These short-term effects need to be evaluated on a case by case basis in order to determine if there would be cumulative effects from projects occurring on other lands in the area.

Recreation in and surrounding the national forest, national parks as well as State and local public lands does not follow administrative boundaries, and therefore changes in management of recreation on all of these lands together affects the long-term economic conditions in local communities. Visitors are drawn to the entire recreational experience of the area and spend time and money near their destinations as well as in communities on the way to their destinations. The revised forest plan (alternative B-modified) is not expected to result in changes to the types of recreational opportunities available on Inyo National Forest. Therefore, the revised plan is not expected to have any long-term cumulative effects on the numbers or types of activities enjoyed in the area. However, events like wildfire that result in closure of areas and in smoke that reduces enjoyment of visiting the area would adversely affect communities whether the fire is burning on the national forest or on neighboring Federal, state, or private lands. The restoration activities in the revised forest plan are expected to reduce the risk of these types of large scale events in the long-term and therefore would have a positive cumulative effect on recreational opportunity and air quality in conjunction with other restoration activities undertaken in the area.

There are no expected long-term changes to grazing use on the Inyo as a result of the final revised plan. The final revised plan does have the potential to result in cost increases for current grazing allotments that are located within the areas recommended for consideration for wilderness. However, there are no expected cost increases to these grazing allotments associated with past or expected future decisions. Therefore, no additional long-term cumulative effects to recreational or grazing use are expected.

Current trends in declining forest product infrastructure and workforce has resulted in only one sawmill remaining south of Yosemite National Park in Terra Bella. The management of all the lands in this area affects future trends in the harvesting of forest products and all of these other benefits need to be considered in conjunction with any changes in the forest plan. The resulting cumulative effects on communities are critical in maintaining economic health, diversity of economic activity, and sustainable fiscal conditions for counties and local municipalities. The operational mills in Terra Bella, Sonora and Chinese Camp are the closest mills to the Inyo National Forest. These mills have long haul distances and narrow roads that typically make transportation prohibitive. Therefore, given the limited use of these mills for Inyo National Forest harvested volumes, no changes resulting from the revised forest plan are expected to have any long-term cumulative effects on the economic sustainability of these mills.

Analytical Conclusions

Alternative A, the current forest plan, would adversely affect the long-term sustainability of all six key national forest benefits that are examined. The continuation of current management activities in the face of current resource conditions and trends is expected to result in more disruptive events, such as uncharacteristic wildfire, and additional declines in forest health that would interrupt and eliminate these benefits. This would have adverse short- and long-term effects on social and economic conditions in local communities and on people’s lives, both those located near the national forest and those across the region that enjoy these benefits.

Alternatives B-modified and B would be expected to help reverse current trends and to improve the long-term sustainability of five of the six key national forest benefits that provide benefits to people locally and across the region. In the short term, effects are mixed across the different national forest benefits. These short-term effects would be adverse for biodiversity and grazing, from increases in potential disturbances related to the increasing of restoration activities. The effects are mixed (both adverse and beneficial) for water, recreation and air quality. Water quality could be affected given the potential for increased sedimentation. Recreation receives benefits in the short term from reduced wildfire imposed closures, but is adversely affected by the potential for restrictions on activities resulting from restoration project activities. Air quality also benefits in the short term from reduced potential for wildfire, but the use of prescribed fire creates the potential for some short-term decreases in air quality as a result of these activities. Energy generation benefits from increased restoration activities that yield biomass and the potential for more water quantity for electricity production. Overall, the alternatives would have long-term beneficial effects on economic conditions in local communities and on the national forests' benefits to people's lives, both those located near the national forest and those across the region that enjoy these benefits. In the short term, there is the potential for disruption to some of these benefits from increased activities, but this potential is less than in alternative D.

Alternative C would be expected to help reverse current trends and to improve the long-term sustainability of four of the six key national forest benefits (water, recreation, air quality and biodiversity) that provide benefits to people locally and across the region. The emphasis on fire for restoration instead of mechanical treatments means that the long-term sustainability of developing biomass utilization for energy generation would be adversely affected. The long-term effects on grazing are uncertain and similar to alternatives B and B-modified. In the short term, the potential effects are similar to those in alternatives B and B-modified with two important differences. Air quality is expected to be adversely affected in the short term as a result of the increased amount of prescribed and managed fire emphasized under alternative C, but given that these events would be planned to occur under favorable conditions, the overall effect is uncertain. For grazing, there is the potential for a short-term benefit from increased restoration using prescribed and managed fire as a primary restoration tool. These restoration activities would reduce woody biomass and increase herbaceous plants in large areas of the Inyo National Forest thus having the potential to improve grazing settings. Overall, alternative C would have some long-term beneficial effects on economic conditions in local communities and on the Inyo's benefits to people's lives. However, there is long-term loss of the opportunities for developing biomass industries as a result of this alternative.

Alternative D would be similar to alternatives B and B-modified and expected to help reverse current trends and improve the long-term sustainability of all six key national forest benefits that provide benefits to people locally and across the region. Key differences with alternatives B-modified and B result from the increased pace and scale of restoration through mechanical treatments in alternative D that could potentially provide even greater benefits to the long-term sustainability of these six national forest benefits. However, this increased intensity would also lead to potential increases in the short term adverse effects resulting from these restoration activities.

Social Conditions

Background

This section summarizes current social conditions in the analysis area for the Inyo National Forest and potential impacts of implementing the revised plan or alternatives on these conditions.

The 2012 Planning Rule requires that plans contain guidance that helps a national forest contribute to social sustainability. In this plan revision effort, desired conditions were developed for the Inyo National Forest to address the following identified needs: supporting the long-term sustainability of forest benefits to people, encouraging the use of partnerships, and improving communication and outreach to the public, including underrepresented populations.

Many of the challenges we face in managing National Forest System lands are rooted in the values that people hold, which influence what is desired from forest management and also help define the quality of life that is important to individuals and communities (Allen et al. 2009). People are often concerned with the potential impacts of changes in land management on their quality of life and at the same time, shifting population demographics also influence value orientations and what is considered important to individuals and communities. These values can change over time and the analysis here is a snapshot of values obtained during the environmental analysis process. Values should be examined at the project level to capture any changes over time. This plan revision effort aims to develop plans that emphasize working together with and understanding the needs of the public in order to manage forests in a way that contributes to social sustainability.

Analysis and Methods

This analysis focuses on three key indicators to examine impacts of alternatives on social conditions: values, civil rights, and environmental justice. While social conditions include a wide range of factors, values were chosen as an indicator because they effectively help us understand differences among alternatives from a social perspective, as well as concerns raised by the public. In addition, examining impacts of alternatives on civil rights and environmental justice are a required part of an environmental impact statement and help ensure more vulnerable populations are considered in land management decisions. These three indicators are described below.

Indicators and Methods

Values

Understanding how people are potentially affected by different alternatives includes looking at what those changes mean in terms of people's different value sets. Several comments received during scoping reveal the diverse values that stakeholders have regarding the management of National Forest System lands. People would be impacted differently because certain alternatives would align more closely with personal values compared to other alternatives. This analysis qualitatively examines potential impacts of alternatives on different value sets. The analysis does not attempt to weigh the impacts on all possible values but instead examines those identified in public comments received during the environmental analysis process.

Based on scoping comments and previous input, including a stakeholder analysis conducted by the Center for Collaborative Policy prior to the assessment phase, we developed broad categories of forest management values that may be affected by different alternatives. We then took these categories along with analyses from other resources areas to summarize the extent to which the different alternatives aligned with different values. This analysis does not discuss every aspect of these very broad values. Rather, it focuses on those aspects that best help us understand differences across alternatives and concerns raised by the public.

The area of focus for this indicator includes the Inyo National Forest. We used information provided by the public regardless of location to examine people's values toward the management of the national forest. This includes viewpoints from both local and regional stakeholders, as well as stakeholders in more distant locations.

Civil Rights

U.S. Department of Agriculture civil rights policy (U.S. Department of Agriculture 2003) requires each agency to analyze the civil rights impact(s) of policies, actions, or decisions that will affect the Department workforce or federally conducted and federally assisted programs and activities. A civil rights impact analysis facilitates the identification of the effects of agency actions that may adversely and disproportionately impact employees or program beneficiaries based on their membership in a protected group.

A protected group is any person, group, or class of persons protected under Federal law and executive order from discrimination on any prohibited basis, that is, discrimination based on race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance programs (U.S. Department of Agriculture 2003).

For environmental or natural resources actions, civil rights impact analyses are not separate reports, but are an integral part of the social impact analysis in the environmental impact statement (U.S. Department of Agriculture 1986).

The theory of "disparate impact" is used in this civil rights impact analysis. Disparate impact is the evenhanded application of neutral policies, actions, or decisions that have the effect of excluding or otherwise adversely and disproportionately affecting protected groups. This analysis qualitatively describes whether:

- Protected groups were provided the same opportunities to participate in the forest plan revision process as others.
- Management under the draft forest plans has the effect of excluding or otherwise adversely and disproportionately impacting protected groups.

The area of focus for this indicator includes the Inyo National Forest. The analysis examines any potential civil rights impacts as a result of the national forest's plan revision process or revised plans. A qualitative analysis of public engagement and review of the scope and nature of public comments was used to assess potential disproportionate impacts to protected groups.

Environmental Justice

Environmental justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment (U.S. Department of Agriculture 1997).

In 1994, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed requiring that each Federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations (Council on Environmental Quality 1997).

The memorandum specifically recognized the role of the National Environmental Policy Act in identifying and addressing environmental justice concerns, particularly related to analyzing environmental effects on minority populations, low-income populations, and Indian Tribes; identifying mitigation measures as appropriate; and providing opportunities for community participation in the environmental analysis process (Council on Environmental Quality 1997).

This analysis examines whether there may be disproportionately high and adverse environmental effects on minority and low-income populations across alternatives. Environmental effects include human health, economic, and social effects. This is done qualitatively by examining whom and where these environmental justice communities may be, describing how they interact with the national forest, and, as a result, how they may be disproportionately and adversely impacted by the different alternatives.

The Council on Environmental Quality has oversight of the Federal government's compliance with Executive Order 12898 and NEPA. They have defined "minority" and "low-income" populations as follows (Council on Environmental Quality 1997):

> Low-income Populations: Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.
>
> Minority: Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
>
> Minority Populations: Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent (may be made up of one minority or a sum of all minorities together) or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

To identify potential environmental justice populations, we used demographic data from the 2011 American Community Survey (ACS) 5-year estimates from the U.S. Census Bureau. The 5-year estimates in 2011 were the most recent data available when originally collected, analyzed, and mapped during the assessment phase. The 5-year estimates were chosen over the 3- or 1-year estimates because they provide information for smaller geographies, are more precise, and better for small populations.

We used the area of influence previously defined for the Inyo National Forest in the assessment phase. This is the set of census county divisions (CCD) that intersects the national forest administrative boundary. Census county divisions are county subdivisions delineated by the United States Census Bureau in cooperation with state, tribal, and local officials for statistical purposes (U.S. Census Bureau 2015). The CCDs and counties associated with the Inyo National Forest are**:** North Mono and Mammoth Lakes CCDs in Mono County; Bishop, Independence, and Lone Pine CCDs in Inyo County; Mina CCD in Mineral County; and Silver Peak CCD in Esmeralda County (see figure 36).

We considered a census county division a minority population if greater than 50 percent of the population identified as non-white or Hispanic/Latino. We considered a census county division a low-income population if the percentage of people below the poverty threshold was substantially greater than at the county level.

In determining the poverty status of families and individuals, the Census Bureau uses income cutoffs that vary by family size, number of children, and age. If the total income of a person's family in the last 12 months is less than the threshold appropriate for that person's family size and composition, then that person is considered "below the poverty level" together with every family member.

To better understand the geographic location of potential environmental justice communities and more specific information regarding race and ethnicity, we examined census block-group-population demographics for the following categories: American Indian and Alaska Native; Asian; Black or African American; Native Hawaiian and Other Pacific Islander; Hispanic or Latino; and Poverty (percent of people whose income is below the poverty level). Census block groups are the second to smallest geographical unit used by the Census Bureau and are generally defined to contain between 600 and 3,000 people (United States Census Bureau 2015). We used this information to identify more specific places that had relatively large minority populations and where outreach efforts could be targeted.

Assumptions

- The framework for the social analysis uses generalities. Area residents and national forest visitors have diverse preferences and values that may not be fully captured in the description of social consequences. The general categories are useful for assessing social impacts based on particular forest-related values.
- Individuals may hold one or more of the values described in this section. As a result, the impacts of alternatives on specific individuals may be cumulative or mixed, depending on the values they hold.
- Demographics are generally the same at the time of writing this analysis as they were during the assessment.

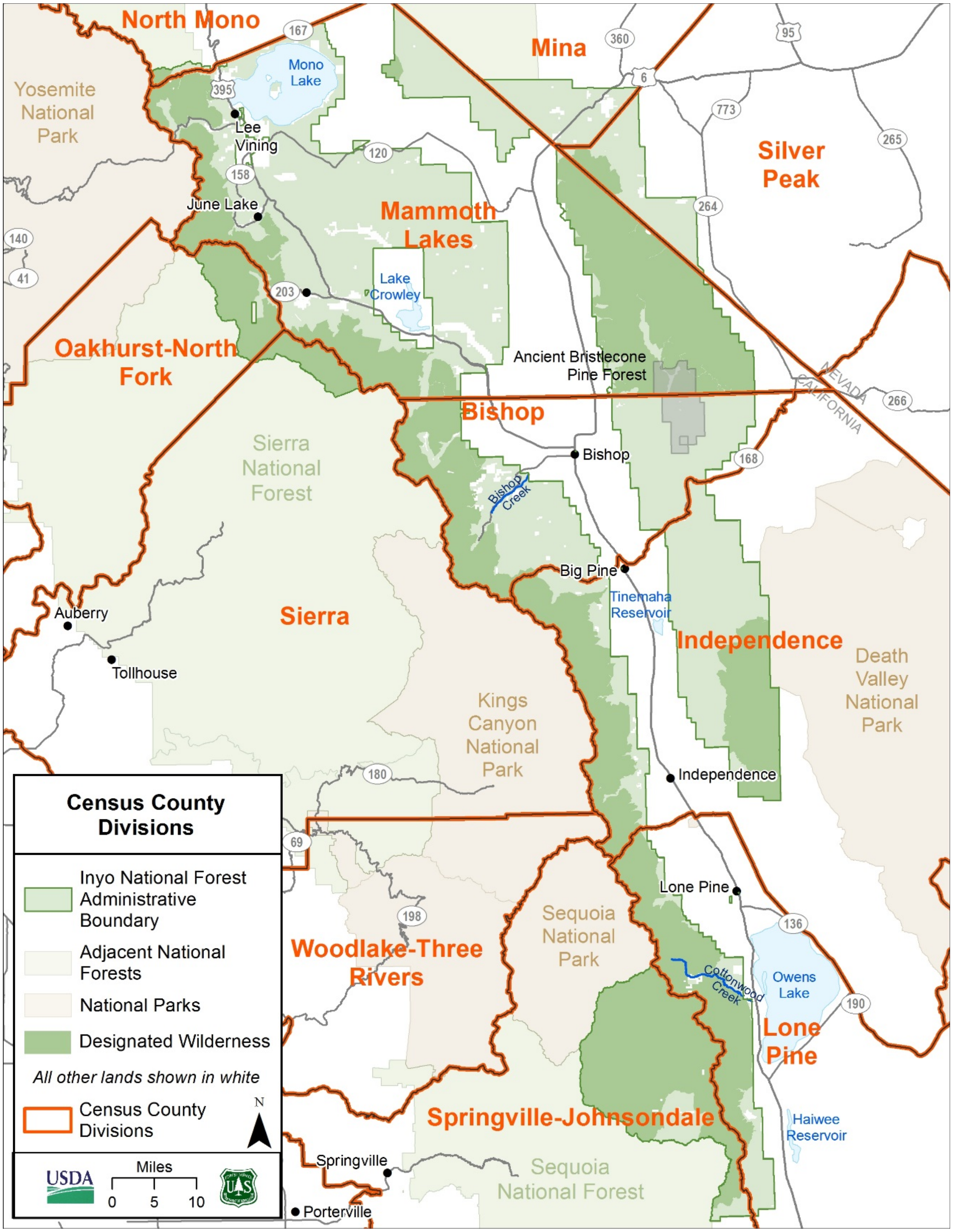

Figure 36. Census county divisions that intersect the Inyo National Forest administrative boundary

Affected Environment

This section describes the social environment of the area relevant to the indicators used in the social impact analysis. More general, comprehensive background information regarding social conditions and trends related to the Inyo National Forest can be found in the national forest assessment.

Values

Values are relatively enduring concepts that people hold and often share within a given society or culture about important life principles, including what is good or bad and desirable or undesirable (Allen et al. 2009). People's values influence how they use national forests, as well as their expectations regarding how National Forest System lands should be managed. The values that people in the Sierra Nevada hold have been passed on through generations. However, values have also been changing over time due to new knowledge, recreation and tourism growth, migration from urban areas, and demographic shifts.

The diverse values that people hold can create complex situations for national forest land management. In addition, many communities outside a national forest's immediate area of influence have an interest in how it is managed, whether they directly use the national forest (such as recreation and tourism) or not (such as water demand from urban and agricultural areas, concern for endangered species; Long, Quinn-Davidson, and Skinner 2014a).

Baseline, representative data regarding public values for the Inyo National Forest are unavailable, so it is not possible to describe what values are most important to the public when it comes to management. However, based on what we heard from stakeholders throughout the revision process, we extracted the broad value categories. Because the viewpoints used to establish different value categories came from volunteered stakeholder responses, they are not necessarily representative of the general public. (Brown, Kelly, and Whitall (2013) reveal differences in national forest values between people who volunteered to participate in a values mapping exercise versus those who were randomly selected to participate. Still, interviews, meetings, and submitted comments often provide the only source of information regarding the national forest values that people hold and help us better understand how national forest management decisions may have an impact on those values. The following sections describe the broad value categories we discerned from people throughout the plan revision process.

Aesthetic – Manage for the Scenery, Sights, Sounds, and Smells of Nature

As described in the national forest assessment, scenery is a major component of people's recreation experience on the Inyo National Forest and greatly contributes to their sense of place and connection with the land. Ecosystem stressors such as excessively dense vegetative conditions, fire-return-interval conditions susceptible to severe wildfire, and outbreaks of insects and diseases continue to diminish valued scenery attributes, particularly socially valued large trees and diverse vegetation.

Biodiversity – Protect Animal and Plant Species and Their Habitat

The diverse landscape of the Inyo National Forest provides a rich array of ecosystems and habitat types that support hundreds of wildlife, fish, and plant species. These species contribute to the lifestyles, cultures, and traditions of many national forest users through activities such as hunting, fishing, plant gathering, and nature viewing. People have also expressed concern regarding adequate protection of habitat for species that are “at-risk,” as described in the “At-risk Species” section.

Cultural – Protect Forest Uses that Help Maintain Traditions and Cultures

Native American culture is inextricably connected to the land. Many Native Americans participate in traditional activities that carry on family and tribal traditions, provide sustenance for families, and continue a spiritual connection to the land and to animal and plant resources (McAvoy, Shirilla, and Flood 2004b). Tribal members have expressed concern about continued use of and access to areas on the Inyo National Forest that support their cultural traditions.

Learning – Support Opportunities to Learn About the Environment, History, and People

The Inyo National Forest fosters people’s connection to nature and each other through education and interpretation. People have expressed a desire to increase outreach, education, and interpretation efforts, particularly related to issues such as fire, invasive species, cultural resources, tribal histories and uses, and recreation etiquette and impacts.

Recreation – Maintain and Enhance a Diverse Set of Recreation Activities

Outdoor recreation is a large part of the culture and lifestyle in the Sierra Nevada and one of the main ways that residents and visitors connect to the land and enjoy the natural world. Recreational trends and the mix of outdoor activities chosen by the public evolve over time, and these demands influence national forest lands and management decisions (USDA Forest Service 2012). Because everyone recreates on the Inyo National Forest in a wide variety of ways, people also have expressed a wide range of concerns regarding potential impacts to their preferred recreation activities. In addition, many people would like to see more opportunities on Inyo National Forest for the types of recreation activities in which they participate.

Wellbeing – Promote and Protect Human Health and Safety

The Inyo National Forest contributes to the well-being of human populations in a variety of ways, including basic life necessities such as clean air and water, physical and mental health benefits, and protection from the spread of fire into communities. People are concerned about the impacts of national forest management decisions on their health and safety, particularly in regard to climate change and expected increases in the occurrence and severity of drought and fire. Many stakeholders are concerned with impacts to water supply, including downstream agricultural and urban communities.

Stakeholders have expressed concerns regarding health impacts associated with increased prescribed fire and wildfire managed to meet resource objectives. People are concerned that these actions would result in prolonged days of smoke exposure, affecting human health, people’s ability to recreate and go about daily activities, and tourism. This is of particular concern to the Inyo National Forest and people living in the eastern Sierra. In addition, people have expressed safety concerns about using prescribed fire or wildfire managed to meet resource objectives near communities, particularly where fuels loads are high. Concerns have been raised regarding impacts to access for fire suppression activities and public evacuation routes in the community wildfire protection zone.

Civil Rights

All members of the public were invited to participate in the plan revision process. The main public notices and meetings held by Inyo National Forest are listed below. No specific information concerning respondents' race, sex, national origin, or age was collected from public comments or meetings.

- On December 26, 2013, the Federal Register published the Forest Service's notice to initiate plan revision for the Inyo, Sequoia, and Sierra National Forests. The public was also notified in the newspaper of record for the Inyo National Forest, the *Inyo Register*.
- In January 2014, public meetings were held in Bishop on the preliminary need to change, desired conditions, and forest roles and contributions. Based on sign-in records, at least 75 people attended the meeting.
- In June 2014, public meetings were held in Bishop on the updated need to change, desired conditions, wilderness inventory, and timber suitability. Based on sign-in records, at least 80 people attended the meeting.
- The notice of intent to prepare an environmental impact statement for revised forest plans was published in the Federal Register on August 29, 2014. The scoping comment period concerning the proposed action in the notice of intent ended on September 29, 2014. The public was also notified in the newspaper of record for the Inyo National Forest. The notice of intent and supporting documents were available to the public on the Forest Service project website. Scoping comments were accepted through the project website, email, hard copy, or fax.
- In September 2014, public meetings were held in Bishop to answer questions about the notice of intent and proposed action and to receive scoping comments. Based on sign-in records, at least 76 people attended the meeting in Bishop. During the scoping period, we received more than 7,200 separate public comment letters or emails from tribes, Federal agencies, state agencies, county governments and agencies, local agencies and organizations, and other groups and individuals.
- In November 2014, public meetings were held in Bishop on scoping issues and the conceptual range of alternatives. Based on sign-in records, at least 80 people attended the meeting.
- In June 2015, the Inyo National Forest held an additional public meeting in Bishop to share information on the wilderness evaluation. Based on sign-in records, at least 50 people attended the meeting.
- In June 2016, the Inyo National Forest held public meetings at the beginning of the 90-day comment period in Mammoth Lakes and Bishop. Based on sign-in records, a total of at least 80 people attend both meetings. Forest staff also participated in public meetings held in Northridge, Los Angeles and San Francisco, and in an on-line webinar. These additional forums reached more than 100 people. All forums were to orient the public to the draft environmental impact statement and draft forest plan.
- In August 2016, the Inyo National Forest held public meetings in Mammoth Lakes and Bishop to answer questions and offer clarification on the draft environmental impact statement and draft forest plan prior to the end of the 90-day public comment period. Based on sign-in records, a total of at least 90 people attend both meetings

Beyond these general public notifications and meetings, the "Environmental Justice" section describes additional efforts the Forest Service made to reach out to more diverse audiences.

There were no comments received that indicated concerns about discrimination based on race, sex, national origin, age, or disabilities during the plan revision process. Inyo National Forest offered accommodations and provided paper copies of forest plan revision materials to people who requested them due to disabilities or other reasons. All web-based materials were developed to be accessible for people with disabilities as required by section 508 of the Rehabilitation Act.

Some senior citizens expressed a desire for meetings closer to home to avoid long drives at night. We also heard this from members of the public from rural mountain communities. Meeting locations and times were based on the availability of meeting space and trying to find centralized locations and times that accommodate the greatest possible attendance. Meetings were adjusted to end earlier over the course of the plan revision process. Forest staffs were also available to answer questions or provide information to those people who could not attend the meetings.

Some comments received during environmental analysis process suggest concerns regarding potentially disparate impacts from the proposed action and are further examined in the "Environmental Consequences" section. These include the following:

- Concerns that new wilderness recommendations would result in road and trail closures that would impact seniors, children, and people with disabilities who rely on motorized or mechanized travel to access the national forest.
- Concerns that new wilderness recommendations would add areas predominantly used by white males and that exclude minorities and women.
- Concerns that prohibiting pack goats in wilderness would impact seniors, children, and people with disabilities who rely on pack goats to access these areas.
- Concerns that prohibiting bicycles on the Pacific Crest Trail would impact people with disabilities who can bike but not walk for long distances.
- Concerns with health impacts of wildfire smoke on seniors, children, and people with health problems.

Environmental Justice

None of the seven CCDs (census county divisions) that make up the Inyo National Forest's area of influence have minority populations over 50 percent (table 114). However, certain areas within or near Bishop, Mammoth Lakes, and Lee Vining have relatively large proportions of their populations who identified as minorities, particularly people who identified as American Indian/Alaska Native and/or Hispanic/Latino.

Of the seven census county divisions that make up the Inyo National Forest's area of influence, the Lone Pine CCD in Inyo County and the Mina CCD in Mineral County have substantially greater percentages of people who are below poverty compared to county levels (table 114). In addition, certain areas within or near Sonora Junction, Mammoth Lakes, and Bishop have relatively large proportions of their populations that are low-income.

Table 114. Percentage of minority populations and people living below the poverty level in the area of influence for the Inyo National Forest

Area	Minority Population	People Below Poverty Level
Mono County	31 percent	11 percent
North Mono Census County Division (CCD)	27 percent	12 percent
Mammoth Lakes CCD	32 percent	11 percent
Inyo County	33 percent	12 percent
Bishop CCD	35 percent	11 percent
Independence CCD	26 percent	7 percent
Lone Pine CCD	35 percent	18 percent
Mineral County	27 percent	22 percent
Mina CCD	0 percent	63 percent
Esmeralda County	20 percent	22 percent
Silver Peak CCD	32 percent	21 percent

Meaningful involvement in decision-making processes is an important part of environmental justice considerations. This includes reaching out to potential environmental justice communities and inviting them to participate in the plan revision process so we can better understand their concerns.

Efforts have been made to engage Tribes early and throughout the plan revision process. In fall 2012, prior to the official start of plan revision, the Center for Collaborative Policy conducted informational interviews with 31 tribal members representing 14 Tribes and tribal organizations associated with the Inyo, Sequoia, and Sierra National Forests. The purpose of the interviews was to better understand tribal concerns that may be relevant to national forest planning, better understand how to improve tribal consultation and involvement, and develop recommendations for tribal involvement during the plan revision process. A Tribal Collaboration and Communication Plan was developed from the results of these interviews to inform how the three national forests would interact with Tribes during the plan revision process.

Tribal forums specific to plan revision related to the Inyo National Forest have been held as described below.

- In January 2014, we held tribal forums in Bishop on the preliminary need to change, desired conditions, and forest roles and contributions.
- In June 2014, we held tribal forums in Bishop on the updated need to change, desired conditions, wilderness inventory, and timber suitability.
- In September 2014, we held tribal forums in Bishop on the notice of intent and proposed action.
- In June 2016, we held a tribal forum in Bishop to orient the tribes to the draft environmental impact statement and draft forest plan.
- In August 2016, we held a tribal forum in Bishop to answer questions and provide clarification to the draft environmental impact statement and draft forest plan.

In addition to the meetings above, we had several meetings with individual Tribes and tribal groups throughout the process that have included forest plan revision as an agenda topic.

In our work and interactions with Tribes and tribal organizations, we have gained a better understanding of tribal interests and concerns related to plan revision. Broad categories of concern include protection of and access to sacred sites, gathering areas, and ceremonial areas; traditional land uses and management, including the role of fire on the landscape; tribal economies; traditional knowledge and education; conflict between recreation uses and traditional tribal activities; and overall forest resilience and sustainability. Further discussion of tribal interests and concerns can be found in the "Tribal Relations and Uses" section.

Aside from tribal communities, limited information is available regarding how minority and low-income populations use and interact with the Inyo National Forest. National and regional information about how minority populations recreate can provide some insights regarding potential uses. Despite a U.S. population that is becoming increasingly ethnically diverse, minority populations are still underrepresented in outdoor recreation (Cordell 2012). Based on national outdoor recreation trends (Mahler 2012), running is the most popular outdoor recreation activity among African Americans, Asian/Pacific Islanders, and Hispanics. Biking is the second most popular activity among African Americans and Asian/Pacific Islanders, while fishing is the second most popular activity among Hispanics. Studies have found that Latinos are primarily day-use visitors, recreate in larger groups, prefer developed sites with amenities and facilities, and often spend extended periods at picnic sites cooking several meals throughout the day (Chavez 2012). Studies on four national forests in southern California show that picnics, barbecues, and playing in streams were among the activities in which Latino visitors usually engaged (Chavez and Olson 2008).

In addition to general public notification, we haves been trying to find new ways to reach out to more diverse audiences to better understand their concerns and how they use the national forest. The Inyo National Forest has expanded outreach to their Spanish language newspaper and is working on coordinating localized interpretation and outreach to the Spanish speaking population. Programs are expected to start late summer to fall that involved several long-term ideas into the upcoming years. We have also starting work with Outdoor Afro, which aims to connect African-Americans with natural spaces and one another through recreational activities.

Continuing to build on this outreach work can help increase diversity in participants in future efforts, particularly projects and activities developed under the revised plans. During this plan revision effort, we have developed a better understanding of where potential environmental justice communities may be located. The Inyo has started to do some work on identifying trusted community contacts who can help provide a bridge between the national forest and these communities. This information can further assist in developing outreach efforts when we are developing projects in certain areas.

Environmental Consequences to Social Conditions (All Alternatives)

Values

Aesthetic – Manage for the Scenery, Sights, Sounds, and Smells of Nature

Scenery is closely tied to vegetation and fire management as described under the "Sustainable Recreation" section. The alternatives differ in terms of ecological restoration objectives, which define the rate at which we aim to move vegetation toward desired conditions. As vegetation and fire-return intervals across more landscapes are restored toward their natural range of variation, the degree to which valued scenic attributes can be sustained through time is expected to increase as well. In the short term, however, some people may perceive restoration activities as having a negative impact to scenery.

Long-term sustainability of scenic character would be at greater risk under alternative A compared to alternatives B, B-modified, or D. Alternative A continues to use the existing visual management system for managing scenery and does not include evaluating the sustainability of scenic character as part of project planning. As described in the "Terrestrial Ecosystems" section, alternative A provides limited treatments across ecological zones.

Alternatives B and B-modified better align with aesthetic values in the long term compared to alternatives A and C, but less than alternative D. These alternatives include evaluating sustainability of scenic character as part of project planning. Alternatives B and B-modified are expected to better integrate management across resources compared to alternative A, particularly in places that are of high recreation importance and where protection of scenic character is especially critical. These alternatives provide more potential for increasing ecological restoration opportunities across ecological zones than alternatives A and C.

Similar to alternatives B, B-modified, and D, alternative C includes evaluating sustainability of scenic character as part of project planning. However, this alternative is more restrictive in terms of ecological restoration opportunities compared to all other alternatives. Therefore, long-term sustainability of scenic character is likely to be at greatest risk under alternative C compared to all other alternatives.

Similar to alternatives B, B-modified, and C, alternative D includes evaluating sustainability of scenic character as part of project planning and is expected to better integrate management across resources compared to alternative A. Compared to all other alternatives, alternative D is expected to best align with aesthetic values in the long term, because it provides the most potential for increasing ecological restoration opportunities across ecological zones.

Biodiversity – Protect Animal and Plant Species and Their Habitat

Fishing, hunting, plant collection, and nature viewing are important activities to people who use the Inyo National Forest. The Forest Service is responsible for managing wildlife habitats on national forest lands whereas individual species are managed by California Department of Fish and Wildlife.

As described in the "Aquatics and Riparian Ecosystems" section, the slow pace of restoration of habitats for aquatic at-risk species under alternative A would result in a continuing risk of downward trend for aquatic species diversity. The goal to increase restoration of aquatic habitats under alternatives B, B-modified, C, and D is expected to address species needs and improve aquatic biodiversity compared to alternative A. While there are different tradeoffs between short-term consequences of restoration and long-term risk of intense wildfire among the alternatives B, B-modified, C, and D, over the long term, they are expected to have similar effects on aquatics species diversity.

As described in the "At-risk Plant Species" section, because broad-scale restoration of ecosystem structure and function would be more limited under alternative A, there may be long-term negative effects to federally listed plant species under this alternative compared to the other alternatives. In comparison to alternatives B, B-modified, C, and D, alternative A would least provide the ecological conditions necessary to conserve candidate species and to maintain or restore their habitats in the plan area, which would contribute to preventing them from being federally listed. Alternative A would consider fewer rare plants in the project planning process, as compared to alternatives B, B-modified, C, and D. Each of the three alternatives would provide for ecological conditions necessary to provide for the persistence of at-risk plant species. However, alternatives B and B-modified would provide the most long-term benefits to species of conservation concern habitat extent and quality. Alternatives B and B-modified would also have the most beneficial short- and long-term effects for whitebark pine.

Ecological restoration and use of wildfire primarily to meet resource objectives is limited in alternative A, providing for less opportunity to create habitat heterogeneity that is needed for many of the hunted and viewable wildlife species. Alternatives B and B-modified continue to provide for large tree and forest canopy cover, as with alternative A, but with additional emphasis to increase the amount of forest restoration treatments to create greater habitat resiliency and heterogeneity. The consequences to hunted and viewable species are expected to be mixed in alternative C with some benefits due to less disturbance, but also less benefit from more limited habitat restoration opportunities compared to alternatives B, B-modified, and D. There is a higher likelihood of very large, high-intensity fires with implementation of alternative C, according to the fire-climate scenario predictions (Westerling et al. 2015), which can have a long-term negative impact on the distribution and sustainability of habitat. Alternative D would have the greatest increase in the pace and scale of ecological restoration of all alternatives, and would provide the most areas with increased vegetation resilience and heterogeneity, which would generally benefit hunted and viewable species. The increased pace and scale of mechanical thinning and use of strategic treatments along ridgetops in alternative D would be expected to produce greater forage for herbivores. The increased restoration of fire as an ecological process would also provide more sustainable forage. This influx of forage also could help bolster predator populations, such as mountain lions, bobcats, and coyotes and other viewable wildlife species.

Cultural – Protect Forest Uses that Help Maintain Traditions and Cultures

All alternatives contribute to the cultural connections that people have with the Inyo National Forest through the various uses and activities that the Inyo provides.

Alternative A does not provide the level of integration of tribal interests and values into project considerations that alternatives B, B-modified, C, and D do. Alternative A only includes existing designated wilderness and does not recommend new areas for inclusion in the National Wilderness Preservation System, allowing for the same level of tribal access to areas traditionally used by Tribes and that may have been part of the wilderness evaluation.

Alternatives B, B-modified, C, and D provide a greater level of integration of tribal interests and values into project considerations than alternative A, due to the addition of new plan components that would be included in each alternative. The increased opportunities for ecological restoration in alternatives B-modified and B are expected to benefit tribal interests by incorporating traditional ecological knowledge, traditional management practices, and tribal involvement into restoration projects. By working with Tribes, more ecological restoration activities are expected to lead to more opportunities that benefit habitats and resources used for traditional purposes. Alternatives B-modified and B recommend new areas for inclusion in the National Wilderness Preservation System on the Inyo National Forest. As described in the “Tribal Relations and Uses” section, while many tribal activities could still occur within areas recommended for wilderness, some activities such as gathering and ceremonial uses may be restricted or more difficult if areas are managed as wilderness.

Due to the limited opportunities for ecological restoration in alternative C, areas and resources of tribal interest are at greatest risk to large, high-intensity wildfire under this alternative. Alternative C recommends the most new areas for inclusion in the National Wilderness Preservation System, which could potentially lead to the most restrictions on traditional tribal uses.

The increased opportunities for ecological restoration in alternative D are expected to benefit tribal interests by incorporating traditional ecological knowledge, traditional management practices, and tribal involvement into restoration projects. By working with Tribes, more ecological restoration activities are expected to lead to more opportunities that benefit habitats and resources used for traditional purposes. Because alternative D provides the most ecological restoration activities, there may be greater risks to inadvertently impacting tribal resources, traditional cultural properties, and sacred sites. However, this is expected to be mitigated through close coordination with Tribes. Alternative D does not recommend new areas for inclusion in the National Wilderness Preservation System, allowing for the same level of tribal access to areas traditionally used by Tribes and that may have been part of the wilderness evaluation.

Learning – Support Opportunities to Learn About the Environment, History, and People

Under alternative A, the Inyo would continue to provide opportunities for people to learn about the environment and the history of the land and its people. However, more opportunities are expected under alternatives B, B-modified, C, and D because of added plan direction related to volunteering, interpretation, partnerships, and stewardship. New plan direction emphasizes the delivery of effective messaging regarding natural and cultural resources, climate change, land stewardship, responsible recreation use, and Native American heritage and culture, as well as communicating regularly with the public about Forest Service projects, management activities, and volunteer and partnership opportunities. This includes consideration of the diverse backgrounds and needs of visitors in developing communication materials. In addition, alternatives B, B-modified, C, and D would include an objective to generate cultural resources products, providing for more cultural learning opportunities. This objective would not vary across alternatives B, B-modified, C, and D and does not exist in current forest plans under alternative A.

Across alternatives B, B-modified, C, and D, there is an increased emphasis on partnerships. Partnerships not only help us do our work, but also create opportunities for learning. While emphasis on partnerships across these alternatives is basically the same, the focus of the partnerships may vary across them. For example, there would be more opportunities for partnerships around primitive recreation in alternative C compared to developed recreation in alternative D.

There is an also and increased emphasis on working with Tribes in alternatives B, B-modified, C, and D compared to alternative A. An important aspect of this coordination is finding opportunities for increased learning and understanding between the agency and Tribes as we carry out projects and activities. Another important aspect includes incorporating traditional ecological knowledge, traditional management practices, and tribal involvement into restoration projects, which may not only improve land management decisions, but also promote transmission of traditions and knowledge to younger generations.

Recreation – Maintain and Enhance a Diverse Set of Recreation Activities

Demand for outdoor recreation opportunities is expected to increase, while the types of recreation activities and experiences that people are seeking would continue to shift. With expected stable or declining agency budgets in the future, the Forest Service would need to rely on volunteers and partners to continue to provide a set of recreation opportunities that meet the need of a growing and changing public. Over the past 15 years, there have been significant declines nationally in programs that contribute to providing recreation opportunities as financial and human resources have been shifted to wildfire management (USDA Forest Service 2015e). This has resulted in the agency being unable to more fully implement sustainable recreation, heritage, volunteer services, wilderness, and wild and scenic rivers programs to provide consistent, quality recreation opportunities to the public. The reductions in funding and staff have also impacted the agency's ability to work with partners and volunteers, as well as to manage permits needed by outfitters and guides and other recreation-focused small business to provide recreation opportunities on National Forest System lands.

Alternatives B, B-modified, C, and D better emphasize sustainable recreation concepts and integrated resource management compared to alternative A. In addition, these alternatives emphasize increasing the sustainability of recreation through stewardship and partnership opportunities with local communities, engaging diverse populations, and targeting highest priority recreation needs to help focus limited resources. However, the types of recreation opportunities that are emphasized vary across alternatives.

The threat of large, high-intensity fire is greater under alternative A (the current forest plan) compared to alternatives B, B-modified, or D due to limited ecological restoration treatments and limited ability to use wildfire to restore and maintain landscapes. As a result, recreation opportunities and access are expected to be more at risk under alternative A, increasing the potential for closures and displacement and associated overcrowding in the long term. The deferred maintenance backlog would continue to grow, further increasing the potential for site and infrastructure closures. Under alternatives B and B-modified, strategic treatment of fuels and treatment is expected to improve sustainability of recreation infrastructure and limit losses and damage due to wildfire, allowing more recreation resources to go toward reducing the deferred maintenance backlog over the long-term. Alternative D includes more opportunities for ecological restoration than alternatives B and B-modified, further decreasing the risk to recreation opportunities from high-intensity wildfires and reducing the potential for closures and displacement over the long term, as well as further reductions in the deferred maintenance backlog. Additionally, alternative D may have the greatest potential to reduce overcrowding compared to other alternatives because it best addresses the growing demand for developed recreation opportunities. Under alternative C, restoration is most limited and recreation opportunities are at greatest risk to negative impacts from high-intensity wildfire. As a result, alternative C has the most potential for increasing overcrowding due to closures and displacement. Under alternative C, the deferred maintenance backlog would increase more than all other alternatives due to its focus on dispersed and undeveloped recreation and more limited opportunities for fuels treatments.

Wellbeing – Promote and Protect Human Health and Safety

There are several aspects of human and community wellbeing that may be influenced by national forest management. This analysis focuses on health and safety related to wildfire. These aspects of wellbeing highlight the main differences expected to occur across alternatives for this value category. As described in the affected environment section, these are some of the most important areas of concern that stakeholders have raised regarding human and community wellbeing. Wildfires are growing larger, becoming more destructive, and occurring more frequently outside the traditional fire season due to vegetation buildup from years of suppression, climate change, and drought. Large, high-intensity wildfires have the potential to negatively affect stream and watershed quality, reduce air quality with increased smoke, and destroy nearby homes and communities.

As described in the “Fire Management” section, managing fires more holistically, rather than trying to emphasize suppression only, is the most effective and efficient way to reduce fuels, reduce impacts to resources and communities, and restore and maintain landscapes. Not enough resources are available to reduce fuels with mechanical or prescribed fire treatments alone on enough areas to effectively reduce the risk to communities. As a result, safety concerns regarding the direct impacts of wildfire are best addressed by alternatives B, B-modified, and D, which use a four-zone approach to categorize risk and remove many of the uncertainties on the location and source of potential damages and benefit to highly valued resources and assets. This allows for more use of wildfire to meet resource objectives and ability to meet overall restoration goals, which ultimately reduces risks to communities. The greater amounts of ecological restoration and the enhancement of strategic fire management features in alternatives B, B-modified, and D, compared to alternatives A and C, further contribute to reducing fire risk to communities and allow for more opportunities for implementing large, prescribed fires or managing wildfire to meet resource objectives. More ecological restoration treatments in alternative D than B or B-modified are expected to further reduce fire risk to communities.

Under all alternatives, there would be continued coordination with local partners and communities for protection and prevention in high wildfire risk areas to enhance the effectiveness of initial response. All alternatives prioritize fuel reduction treatments around communities. However, alternatives A and C do not account for the likelihood of fires to spread from adjacent areas that contribute to the risk to communities or infrastructure. Because risk-based zones are not used in alternative A, opportunities for using wildfire to restore and maintain landscapes are greatly limited. Additionally, mechanical fuels treatments are more limited under alternative A than alternatives B, B-modified, and D. Alternative C includes the risk-based wildfire maintenance zone that alternatives B, B-modified, and D have, allowing for more wildfire managed to meet resource objectives within this zone. However, this alternative has the least amount of mechanical fuel reduction, as well as higher uncertainty of where risk resides, so there are less options for fire management outside this zone.

As described in the “Aquatic and Riparian Ecosystems” section, the risk to water quality over the long term increases as the risk of large, high-intensity wildfire increases. The risk of these types of fires is most reduced under alternative D, because the greatest amount of ecological restoration is expected to occur under this alternative, followed by alternatives B-modified, B, A, and C, respectively. While fuels management activities such as mechanical treatment and prescribed fire can have a variety of negative, short-term impacts to soil and water quality, implementation of best management practices can effectively mitigate potential impacts from these actions. In addition, alternative D is expected to have the greatest number of properly functioning watersheds that are resilient to the impacts of climate change due to the amount of ecological restoration in aquatic and riparian systems that is expected to occur.

As described in the “Fire Management” section, smoke management opportunities are limited during large wildfires and can result in serious air quality impacts, disrupting the lives of residents and adversely impacting human health. The level of smoke emissions from large wildfires is expected to double over the next half a century, given current vegetation conditions and trends in climate and fire ignitions. Under the current forest plan in alternative A, there would generally be a continuation of current trends in large wildfires that produce large smoke emissions. Alternative A does not contribute to altering current trends or improving the long-term sustainability of air quality benefits that the national forests provide to people. Under alternatives B, B-modified, and D, there would be more prescribed fire, thinning, and in some areas wildfires managed to meet resource objectives. All of these restoration activities would reduce potential emissions from large, undesirable wildfires. There would be increased smoke emissions from prescribed fires, but prescribed fires are generally planned under favorable conditions for smoke dispersion to limit human health impacts, impacts to transportation corridors, and smoke sensitive populations. Emissions from prescribed fire can be managed to reduce short-term impacts on air quality more effectively than emissions from wildfire. Alternatives B, B-modified, C, and D contribute to reducing current trends in large uncharacteristic wildfires that adversely affect the long-term sustainability of air quality. However, under alternative C, there is less mechanical thinning proposed than in alternatives B, B-modified, and D. As a result, prescribed fires would have a greater quantity of smoke associated with restoration activities because more fuels are available to burn. In addition, the ability of alternative C to alter current trends depends on the extent to which larger, landscape prescribed burning occurs.

Civil Rights

The Inyo National Forest is open to all groups for activities allowed under existing laws, regulations, and policies. This will not change under any alternative. Specific concerns described in the affected environment section that were raised during the environmental analysis process are further discussed below.

Members of the public expressed several concerns regarding potential wilderness recommendations. The concerns expressed were that potential wilderness recommendations would result in road and trail closures that would impact seniors, children, and people with disabilities who rely on motorized or mechanized travel to access the Inyo National Forest. Changes to the trail and road system are project-level decisions and are not part of the plan revision process. While motorized and mechanized travel is considered unsuitable in recommended wilderness areas, current, authorized uses of roads and trails will not change under any alternative for the following reasons:

- Unless restricted by law or regulation, the plan alone cannot prohibit public uses without a closure order from the responsible official. To prohibit a use, the responsible official needs to analyze the effects of a proposed closure and issue a project decision. Without a closure order, public uses may continue even if the uses are not considered suitable on the lands where they are occurring. Plan components can, however, bar the Forest Service from authorizing such uses, for example, when they would be conducted as an event requiring a special use authorization.
- Proposed changes to roads and trails within recommended wilderness areas would need to be analyzed at the project level for adverse and disproportionate impacts on seniors, children, and people with disabilities.

Concerns were also raised that prohibiting pack goats in wilderness would impact seniors, children, and people with disabilities who rely on pack goats to access these areas. No changes regarding the use of pack goats within wilderness are being made under the current forest plan revision process. Wilderness areas are currently open to the use of pack goats. However, further determinations of the appropriate use of pack goats within certain areas may be made at the project level.

The final wilderness concerns raised were that new wilderness recommendations would add areas predominantly used by white males and that exclude minorities and women. All areas on the national forest, including recommended wilderness, are open to all members of the public. Based on the latest national visitor use monitoring data for Inyo National Forest, people from culturally diverse backgrounds are generally underrepresented as visitors. The vast majority of visitors are white, non-Hispanic, and male. The Forest Service recognizes the demographic shifts that are occurring locally and regionally and is working to better understand how and why people do and do not visit national forests, as well as outreach to underrepresented populations. Research has shown that people from culturally diverse backgrounds may not be visiting national forests for a variety of reasons, including comfort and safety, accessibility, strong and positive connections, and lack of information (Roberts et al. 2009). Under alternatives B, B-modified, C, and D, there are plan components to consider diverse backgrounds in designing communication and interpretive messages, as well as to actively engage urban populations, youth, and underserved communities in educational and community outreach programs. In general, there is more emphasis within plan components on connecting people with nature.

In addition to concerns related to wilderness, members of the public expressed concerns that prohibiting bicycles on the Pacific Crest National Scenic Trail would impact people with disabilities who can bike but not walk for long distances. No changes regarding bicycle use on the Pacific Crest National Scenic Trail are being made under the current forest plan revision process. Regional Order 88-4 currently prohibits using or possessing bicycles on the Pacific Crest National Scenic Trail along the entire length of the trail.

Other concerns regarding potential health impacts of wildfire smoke on more vulnerable populations, including seniors, children, and people with health problems were also expressed. While most healthy adults and children are expected to recover quickly from smoke exposure and not have long-term consequences, certain sensitive populations may experience more severe short-term and chronic symptoms, including people with respiratory problems, the elderly, and children (California Air Response Planning Alliance 2008). As described above and in the “Fire Management” section, the level of smoke emissions from large wildfires is expected to double over the next half a century, given current vegetation conditions and trends in climate and fire ignitions. No alternative offers both short-term and long-term improvements to air resource indicators. Restoration treatments would slow the progress of increasing wildfire emissions. As a result, alternative D has the highest short-term emissions from treatments followed by alternatives B-modified and B and then C. In the long term, alternative D would result in the greatest reduction in emissions from wildfires followed by alternatives B-modified, B, C, and lastly A. Alternatives B, B-modified, C, and D also include goals to help the public reduce smoke exposure through early notification and outreach efforts and participation in interagency collaborative smoke management. In addition, alternatives B, B-modified, C, and D include a guideline to identify mitigation actions for smoke-sensitive areas when managing wildfires and prescribed burns.

Environmental Justice

Because we do not have good data on how low-income populations use Inyo National Forest, it is difficult to examine how the alternatives may impact them. As described above in the “Economic Conditions” section, the counties bordering the Inyo National Forest can have higher unemployment, lower earnings, and lower per capita income compared to California as whole. They are likely more vulnerable to national forest management changes that affect key economic sectors, as well as the impacts of large, high-intensity wildfires. While there is no indication that any alternative disproportionately impacts low-income populations, the alternatives have varying effects creating more resilient landscapes. As described in the “Economics” section, over the long term, alternatives B, B-modified, and D are likely to have beneficial effects on economic conditions in local communities. As such, these alternatives are not expected to exacerbate the poverty rate or disproportionately worsen the economic well-being of low income individuals over the long term. Alternative C is likely to have some beneficial effects, but with losses in the forest products and biomass industries. Alternative A is expected to have overall adverse effects on economic conditions in local communities. It will be important to better understand how low-income populations are using the national forest and how management actions impact them. This may be particularly true for projects that occur near key places where relatively large proportions of the population are low-income, as described in the affected environment section.

Native American Tribes have integral connections to the national forest that cross an array of social institutions, including family, government, economy, education, and religion. Areas across the Inyo play a key role in defining these institutions. As a result, all aspects of national forest management are generally of great interest to Tribes. As described in the “Tribal Relations and Uses” section, alternative C is the only alternative that may result in an incremental loss of sites or diminished access to resources used by Tribes over time due to the high risk of large, high-intensity wildfires. In addition, alternatives B, B-modified, and C include new recommended wilderness areas, potentially impacting tribal access to and use of culturally important areas. Alternative D provides the most opportunities to restore sites and resources important to Tribes and to reduce the threats from large, high-intensity wildfires due to the increased amount of vegetation management treatments. At the same time, alternative D would require additional coordination to protect these sites and resources due to the increased amount of mechanical treatments. All alternatives would address minimizing impacts to Tribes at specific locations during project planning, and alternatives B, B-modified, C, and D include specific plan direction to incorporate opportunities to improve sites and resources important to Tribes during project planning.

There is limited information regarding the use of Inyo National Forest by other minority populations. Currently, people from culturally diverse backgrounds are still underrepresented as national forest visitors according to the Forest Service national visitor use monitoring data. This may be due to language barriers, lack of information, or other constraints (Roberts et al. 2009). Based on the lack of information about how minority groups use the national forest, it is difficult to determine how the alternatives could impact them. However, there is no indication that the alternatives are expected to disproportionately and adversely impact minority populations.

Based on general observation at public meetings, there has been limited involvement by minority populations, aside from Tribes, during the plan revision effort. In order to have more involvement from culturally diverse stakeholders in processes such as plan revision, a relationship first needs to exist between Inyo National Forest staff and minority populations to provide a foundation to work from and build on. During the plan revision process, the Inyo staff has pursued efforts to start building those relationships and to outreach in new ways that may be more effective at reaching minority populations.

Cumulative Effects

Other federally managed lands in the area, including lands managed by the National Park Service and Bureau of Land Management, support the diversity of values that people hold for the natural landscapes in the southern Sierra Nevada. Restoration efforts across all lands would be important to sustaining these landscapes and how they contribute to people's lives. As described in the "Terrestrial Ecosystems" section, under all alternatives, the impacts of climate change and increased probability of large, high-intensity fires may override the beneficial impacts of restoration treatments, particularly in the near term while projects are being planned and implemented. There is uncertainty as to when or where large, high-intensity fires may occur or severe drought. The role that the Inyo National Forest will play in the future in supporting certain values may change over time as the landscape changes. In addition, demographic, cultural, and societal changes will continue to influence how people use their national forest and what is important to them in terms of forest management.

Analytical Conclusions

The current forest plan, alternative A, does not contribute to sustaining a diverse set of forest-related values in the long term as much as alternatives B, B-modified, and D. Current trends of increasing fire activity, drought, and insect outbreaks pose the greatest threat to many of the values people have related to the national forest because these values are heavily dependent on resilient ecosystems that can support a variety of uses and needs in the long term. Because ecological restoration treatments are limited under alternative A, values are more at risk to negative impacts over the long term.

Alternatives B and B-modified effectively support a diverse set of forest-related values in the long term. These alternatives provide for increased ecological restoration over the planning period compared to alternative A and C, though less than D. As a result, alternatives B and B-modified effectively moves forest conditions closer to ecosystem desired conditions and fire resilient landscapes, though not as quickly as alternative D. By moving toward these desired conditions, aesthetic, biodiversity, cultural, economic, learning, recreation, and wellbeing values are sustained over the long term. In terms of biodiversity values, alternatives B-modified and B are expected to provide more long-term benefit for plant species of conservation concern habitat than all other alternatives.

Similar to alternative A, alternative C does not contribute to sustaining a diverse set of forest-related values in the long term as much as alternatives B, B-modified, and D because ecological restoration treatments are also limited under alternative C. Values are more at risk to negative impacts over the long term. Biodiversity and learning value sets under alternative C are better aligned than continuing with current management direction under alternative A.

Alternative D best supports a diverse set of forest-related values in the long term compared to all other alternatives. Alternative D provides for the greatest amount of ecological restoration over the planning period, moving us closer than other alternatives to ecosystem desired conditions and fire-resilient landscapes. As a result, alternative D best aligns with sustaining aesthetic, cultural, economic, learning, recreation, and wellbeing values over the long term. Alignment with biodiversity values are somewhat mixed. Alternative D best aligns with values related to hunting and viewing terrestrial wildlife. Alternatives B, B-modified, C, and D provide similar alignment with values related to aquatic species. Alternatives D and C provide more long-term benefits to plant species of conservation concern habitat than alternative A, but less than alternatives B-modified and B.

Management direction under all alternatives is not expected to adversely or disproportionately impact protected groups. In addition, alternatives B, B-modified, C, and D include plan components to improve communication with and outreach to more diverse audiences and often underrepresented populations, as well as to increase connections between Inyo National Forest and people in general. Through this effort, we have heard concerns in particular related to impacts to seniors, children, and people with disabilities. Future projects will need to evaluate whether there may be adverse and disproportionate impacts to these and other protected groups. It will be important to continue to learn about how these groups use the national forest and potential impacts of the national forest on them.

Other Required Disclosures

Unavoidable Adverse Effects

The revised forest plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Therefore, decisions made in the land management plan do not cause, or have the potential to result in, actual irreversible or irretrievable commitment of resources (see next section). Application of the land management plan standards and guidelines during future project and activity decisionmaking would provide resource protection measures and limit the extent and duration of any adverse environmental impacts. For a detailed discussion of types of consequences expected from future activities, see specific topic areas in this chapter.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road.

The revised plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the land management plan does not authorize or mandate any site-specific project or activity (including ground-disturbing actions), none of the alternatives cause an irreversible or irretrievable commitment of resources.

Short-term Uses and Long-term Productivity

The National Environmental Policy Act (NEPA) requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by Congress, this includes using “all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans” (National Environmental Policy Act, section 101). Short-term uses are those that generally occur for a finite time period. Long-term productivity refers to the ability of the land to produce a continuous supply of a resource.

The change in the programmatic management of the Inyo National Forest under alternatives B, B-modified, C, or D would not jeopardize the short-term or long-term productivity of the lands and resources of the Inyo National Forest. Discussion of short- and long-term effects is included in the analysis of the environmental consequence for each need for change.

Laws Requiring Consultation

The regulations for implementing the National Environmental Policy Act at 40 CFR 1502.25(a) direct “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with . . . other environmental review laws and executive orders.” As a proposed Federal project, the revised plan decisions are subject to compliance with other Federal and State laws. Determinations and decisions made in the revised plan have been evaluated in the context of relevant laws and executive orders. Throughout the development of the revised plans, there has been collaboration with various State and Federal agencies. The following actions have been taken to document and ensure compliance with laws that require consultation and/or concurrence with other Federal agencies.

- Endangered Species Act, Section 7: Consultation with the U.S. Department of the Interior, Fish and Wildlife Service, regarding federally listed threatened, endangered, and proposed species, and designated and proposed critical habitat is in progress. A biological assessment for federally listed species has been prepared and submitted to the U.S. Fish and Wildlife Service for consultation according to the Endangered Species Act.
- National Historic Preservation Act: Consultation with the California and Nevada State Historic Preservation Officers is mandated by section 106 of the National Historic Preservation Act. The Programmatic Agreement Among The USDA Forest Service, Pacific Southwest Region (Region 5), California State Historic Preservation Officer, Nevada State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Processes for Compliance with Section 106 of the National Historic Preservation Act for Management of Historic Properties by the National Forests of the Pacific Southwest Region was executed in December 2012. This Programmatic Agreement prescribes the manner in which Region 5 and the State Historic Preservation Officer shall cooperatively implement this Programmatic Agreement in California and portions of Nevada. It is intended to ensure that Region 5 organizes its programs to operate efficiently and effectively in accordance with the intent and requirements of the National Historic Preservation Act and that Region 5 integrates its historic preservation planning and management decisions with other policy and program requirements. The Programmatic Agreement streamlines the National Historic Preservation Act section 106 process by eliminating case-by-case consultation with the State Historic Preservation Officer on undertakings for which there is no or little potential to affect historic properties and for undertakings that either culminate in no historic properties affected or no historic properties adversely affected with approved Standard Protection Measures (36 CFR 800.4(d)(1) and 800.5(d)(1).
- Government-to-government consultation was completed with American Indian tribes who have aboriginal territory within the lands now part of the Inyo National Forests, as required by the National Historic Preservation Act; Executive Orders 13007 and 13175; and the Programmatic Agreement cited above. More information on this consultation can be found in the “Public Participation” section of chapter 1 and in the “Tribal Relations and Uses” section of chapter 3 of this document.

Chapter 4. Preparers, Consultation, and Coordination

Preparers and Contributors

The following individuals and Forest Service staff groups contributed to development of this environmental impact statement. A steering committee guided the plan revision process comprised of: the Forest Supervisors of the Inyo, Sequoia, and Sierra National Forests; the Regional Office Directors of Ecosystem Planning, Ecosystem Management, and Public Services; and a representative from the Forest Service Office of General Council.

Responsible Officials

Tammy Randall-Parker, Forest Supervisor for the Inyo National Forest.

Interdisciplinary Team Members

The interdisciplinary team was comprised of a core team and an extended team. While all interdisciplinary team members contributed to the development of the draft and final environmental impact statements and forest plan, the core team members and primary authors of the statement are listed below and their major contributions are noted in parentheses in the "Title and Contribution" section. The term "detail" indicates a formal or informal temporary work assignment to the interdisciplinary team.

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Name	Title and Contribution	Education and Experience
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Support to the Interdisciplinary Team

Review and input to the development of the draft revised plans and draft environmental impact statement were received from the staffs of the Inyo, Sequoia, and Sierra National Forests Supervisor's Office and Ranger Districts, and the Pacific Southwest Regional Office. Additional Geographic Information System support was provided by staff on the three national forests, the Pacific Southwest Regional Office, and the Pacific Southwest Region Remote Sensing Laboratory. Many other staff and contractors have contributed support to the development of the proposed forest plans and the draft environmental impact statement and are not listed.

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Consultation and Coordination

The Forest Service consulted the following Tribes; Federal, State, and local agencies; groups; and individuals during development of this environmental impact statement. Tribes, agencies, and others who provided comments during the scoping period are indicated with an asterisk following their name.

Tribes and Tribal Organizations

The following Tribes and tribal organizations or associations were consulted:

American Indian Council of Mariposa

Antelope Valley Indian Community

Benton Paiute Reservation Utu Utu Gwaitu Paiute Tribe

Big Pine Paiute Tribe of Owens Valley

Big Sandy Rancheria

Bishop Paiute Indian Tribal Council

Bridgeport Paiute Indian Colony

Chaushilha Yokuts

Cold Springs Rancheria

Council for the Interpretation of Native Peoples

Dumna Wo-Wah Tribal Government

Dunlap Band of Mono Indians

Ft. Independence Community of Paiute Indians

Haslett Basin Traditional Committee

Kawaiisu Tribal Council

Kern River Paiute Council

Kern Valley Indian Community

Kern Valley Indian Council

Kitanemuk & Yowlumne Tejon Indians

Lone Pine Paiute-Shoshone Reservation

Monache Inter-Tribal Association

Mono Lake Kutzadika’a Tribe

Mono Nation

North Fork Mono Tribe

North Fork Rancheria

Picayune Rancheria of Chukchansi Indians

Sierra Mono Museum

Sierra Nevada Native American Coalition

Southern Sierra Miwuk Nation

Table Mountain Rancheria

Tachi-Yokuts- Santa Rosa

Tejon Indian Tribe

Timbisha Shoshone of Death Valley

Timbisha Shoshone Tribe (Bishop)

Tubatulabel Tribe of Kern Valley

Tule River Indian Tribe

Walker River Paiute Tribe

Washoe Tribe of Nevada and California

Wukchuni Tribal Council

Wuksachi Tribe

Yurok Tribe

Federal, State, County, and Local Agencies and Organizations

Numerous Federal, State, county, and local agencies and organizations have been consulted in development of the revised plan and this environmental impact statement. Complete mailing lists for the scoping periods are available in the planning record. Some of the agencies consulted include:

Cooperating Agencies

In accordance with 36 CFR 1501.6, "any other Federal agency which has jurisdiction by law shall be a cooperating agency. In addition any other Federal agency which has special expertise with respect to any environmental issue, which should be addressed in the statement may be a cooperating agency upon request of the lead agency." The U.S. Environmental Protection Agency is a cooperating agency. In accordance with 36 CFR 219.4(a)(1)(iv), "…Where appropriate, the responsible official shall encourage States, counties and other local governments to seek cooperating agency status in the NEPA process for development, amendment, or revision of a plan." Inyo County is a cooperating agency, and contributed significantly to the economic data development and analysis in the plan, among other areas.

Federal Agencies and Representatives

The U.S. Environmental Protection Agency is a cooperating agency.

National Park Service, Death Valley National Park

National Park Service, Devils Postpile National Monument

National Park Service, Sequoia and Kings Canyon National Parks

National Park Service, Yosemite National Park

U.S. Army Corp of Engineers

U.S. Department of Transportation, Federal Highways Administration

USDA, Forest Service, Humboldt-Toiyabe National Forest

USDA, Natural Resource Conservation Service

USDA, Pacific Southwest Research Station

USDA, Pacific Southwest Research Station, Redwood Science Lab

USDI, Bureau of Land Management

USDI, Bureau of Reclamation

USDI, Office of Environmental Policy and Compliance

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

U.S. Geological Survey

U.S. Marine Corps, Mountain Warfare Training Center

U.S. Navy, China Lake Naval Air Warfare Center

U.S. Navy, Naval Air Station Lemoore

U.S. Navy, Naval Facilities Engineering Command Southwest Division

U.S. Representative 4th District

U.S. Representative 8th District

U.S. Representative 20nd District

U.S. Representative 21nd District

U.S. Representative 22nd District

U.S. Representative 23rd District

U.S. Senator, Barbara Boxer

U.S. Senator, Dianne Feinstein

State Agencies

California Air Resources Board

California Department of Fish and Wildlife

California Department of Forestry and Fire Protection

California Department of Justice

California Department of Parks and Recreation, Office of Historic Preservation

California Department of Transportation

California Regional Water Quality Control Board

Lahontan Regional Water Quality Control Board

Nevada Department of Wildlife

Nevada Division of Environmental Protection

Nevada Division of Forestry

County Governments and Agencies

Inyo County is a cooperating agency for the Inyo National Forest.

California Assemblywoman 32nd District

California Assemblywoman 34th District

California Governor

California Senator 14th District

California Senator 16th District

California Senator 18th District

Fresno County Board of Supervisors

Fresno County Department of Public Works

Inyo County Agricultural Commissioner

Inyo County Board of Supervisors

Inyo County Planning Department

Inyo County Public Works Department

Inyo County Water Department

Esmeralda County Commissioners

Esmeralda County Road Department

Kern County Air Pollution Control District

Kern County Board of Supervisors

Kern County Board of Trade

Kern County Fire Department

Kern County Parks and Recreation

Kern County Planning Department

Madera County Board of Supervisors

Mariposa County Board of Supervisors

Mineral County Commissioners

Mineral County Public Works Department

Mono County Community Development

Mono County Environmental Health

Mono County Local Transportation Commission

Mono County Public Works Department

Tulare County Board of Supervisors

Tulare County Office of Education

Tulare County Parks & Recreation

Tulare County Planning Department

Tulare County Resource Management Agency

Tuolumne County Board of Supervisors

Local Agencies and Organizations

Apple Valley Town Hall

Bakersfield City Council

Bakersfield College Library

Bakersfield Convention and Visitors Bureau

Big Pine Community Services District

Carlton College, Gould Library

City of Bishop

City of Bishop, Chambers of Commerce

College of the Sequoias Library

CSU Bakersfield, Walter W. Stiern Library

CSU Fresno, Henry Madden Library

Eastern Sierra Transit Authority

Fresno City College Library

Fresno City Council

Fresno County Public Library
Independence - Chamber of Commerce
June Lake - Chambers of Commerce
June Lake Public Utility District
Kings River Conservation District
Kings River Water Association
Kern County Black Chamber of Commerce
Kern County Hispanic Chamber of Commerce
Kern County Library
Kern River Valley Chamber
Kern River Valley Council
Kern River Valley Fire Safe Council
Kern River Watermaster
Kings County Public Library
Lake Isabella Public Library
Lee Vining Public Utility District
Lone Pine - Chamber of Commerce
Los Angeles Department of Water and Power
Mammoth Community Water District
Mammoth Lakes Chamber of Commerce
Mammoth Lakes Fire Protection District
Merced County Public Library
Midland School
Mojave Desert-Mountain RC&D
Montana State University
Porterville City Library
Porterville City Planning Department
Porterville College Library
Reedley College
Ridgecrest Chamber of Commerce
Ridgecrest Public Library
Rolling Green Utilities
San Joaquin Valley Air Pollution Control District
Shafter-Wasco Irrigation District
Town of Mammoth Lakes
Town of Mammoth Lakes Public Works
Tulare County Library
Tulare Kings Hispanic Chamber of Commerce
University of Arizona
University of California, Berkeley
University of California, San Diego
University of California, Stanislaus
Visalia City Council

Others

Numerous groups and individuals participated in the process through written comments and by attending public meetings. Complete mailing lists are available in the public record. Some of the groups that provided comment include:

Alliance for Environmental Concerns
American Forest Resource Council
American Lands Access Association
American Whitewater
Back Country Horsemen
Bakersfield Californian
Bakersfield Trailblazers
Bakersfield Yamaha
Baymiller Family Trust
Blue Ribbon Coalition, Inc.
Brechbuehl Timber
The Bristlecone Chapter of the CNPS
Brown-Berry Biological Consulting
Californians for Alternative to Toxics
California Association of 4WD Clubs, Inc.
California Cattlemen's Association
California Equestrian Trails Coalition
California Forestry Association
California Indian Basketweavers Association
California Institute of Technology, Combined Array for Research in Millimeter-wave Astronomy (CARMA)

California Land Management
California Native Plant Society
California Off-Road Vehicle Association
California Trail Users Coalition
California Trout, Inc.
California Wilderness Coalition
CalWild
Camp Max Straus
Camp Nelson Mutual Water Company
Camp San Joaquin
Carver Bowen Ranch
Cedarbrook Cabin Owners
Center for Biological Diversity
Church of Jesus Christ of Latter Day Saints
Concerned Citizens – Piutes
Cyrus Partners
D&B Partnership
The Daily Independent
David Wood Ranches
Dinuba Centinel
Dowville Tract Association
Dunn School
Eagle Rafting
Eastern Sierra Audubon Society
Eastern Sierra Interpretive Association
Eastern Sierra Recreation Collaborative
Equestrian Trails and Lands
Eshom-Kaweah Ranch
Evergreen Helicopter, Inc.
Far Horizons, Inc.
Fresno Bee
Friends of the Inyo
Geos Institute
Giant Sequoia National Monument Assn
Guest Services, Inc.
Hafenfeld Ranch
High Desert Multi Coalition
High Sierra Guide Service
HMS Veterinary Development, Inc.
Hume Lake Christian Camps
Huntington Lake Association
Inland Valley Mountain Bike Association
International Mountain Bicycling Association
John Muir Project
Kern River Courier
Kern River Revitalization
Kern River Tours
Kerncrest Audubon
Kiper & Kiper
Klamath Forest Alliance
KMPH TV Channel 26
Lake Isabella-Bodfish Property Owners Assn
Mammoth Lakes Recreation
Mammoth Mountain Ski Area, LLC
Mammoth Times
McGee Creek Pack Station
Mammoth Lakes Trails and Public Access Foundation
Mike Berry Guide Service
Mono Hot Springs Resort
Mono Lake Committee
National Forest Recreation Association
Natural Resources Defense Council
News Review (Ridgecrest)
North American Packgoat Association
Northern California Society of American Foresters
OA Outfitting Inc., KR Outfitter
Off Road Vehicle Watch
Outdoor Alliance
Pacific Crest Trail Association
Pacific Crest Trail Reassessment Initiative
Pacific Gas and Electric
Pacific Rivers Council
Particle Media Group
Pecks Camp
Ponderosa Lodge
Ponderosa Property Owners

Q.A.B. Media
Quaker Meadow Ministries
Recreational Aviation Foundation
R.M. Pyles Boys Camp
Roger Camp Homeowners Association
Sageland Ranch
San Joaquin Houndsmen Club
San Joaquin River Trails Council
Santiago Outfitter Fishing
Sequoia Crest
Sequoia Forest Alliance
Sequoia Forest Keeper
Sequoia Lake Conference of YMCA
Sequoia Snowmobilers
Sierra Club
Sierra Forest Legacy
Sierra Forest Products
Sierra Reader
Snowlands Network
Southern California Edison
Southern Mono Historical Society
Southern Sierra Fat Tire Association
Spanish Radio Group
Stewards of the Sequoia
Stewards of the Sierra
Sugarloaf Community Group
Sugarloaf Mountain Park
Sustainable Forest Action Coalition
Tehachapi Mountain Trails Association
Track and Trail Publications
Trout Unlimited
Tulare County Audubon Society
Tulare County Sportsman
United Church of God
United Trail Maintainers of California
Upper Tule Association, Inc.
Upper Tule News
Visalia Times Delta
West Coast Development Co.
Western Watersheds Project
White Mountain Research Center
Whitewater Voyages
WildEarth Guardians
The Wilderness Society
Winter Wildlands Alliance
W.M. Beaty & Associates, Inc.

Agencies, Organizations, and Persons Sent Copies of the Final Environmental Impact Statement

This environmental impact statement has been distributed to, or made electronically available to, over 3,300 individuals and groups who specifically requested a copy of the document or commented during public involvement opportunities. In addition, copies have been sent (or in some cases made electronically available) to Federal agencies, federally recognized Tribes, State and local governments, and organizations that have requested to be involved in the development of this analysis. Some of these entities include the U.S. Environmental Protection Agency; U.S. Department of the Interior; Advisory Council on Historic Preservation; USDA National Agricultural Library; State wildlife and fisheries management agencies; Tribes; county supervisors; and local community governments. Due to the number of people, agencies, and organizations, a complete listing has been omitted from this environmental impact statement, but is available upon request.

Glossary

Active management: Planned, intentional actions in an area that are specifically designed to obtain or move toward a desired objective or result.

Adaptive management: An approach to natural resource management in which decisions are made as part of an ongoing process. Adaptive management involves planning, implementing, monitoring, evaluating, and incorporating new knowledge into management approaches based on scientific findings and the needs of society. Effects are monitored for the purpose of learning and adjusting future management actions, which improves the efficiency and responsiveness of management.

Administrative site: Areas such as work centers, fire lookouts, permitted ranch headquarters, seed orchards, communication sites, utility corridors, developed campgrounds, and other areas that are occupied or used by the Forest Service during the administration of work associated with national forest lands.

Administrative use: Use by the Forest Service.

Allowable sale quantity (ASQ): The quantity of timber that may be sold from the area of suitable land covered by the land management plan for a time period specified by the plan. This allowable sale quantity (ASQ) is usually expressed on an annual basis as the "average annual allowable sale quantity." For timber resource planning purposes, the allowable sale quantity applies to each decade over the planning horizon and includes only chargeable volume. Consistent with the definition of timber production, ASQ does not include firewood or other nonindustrial wood in the allowable sale quantity.

Aspen clone: A genetically identical set of aspen trees all connected by the same root system, as in vegetative reproduction. A clone is a distinct aspen stand, or it may be a smaller inclusion within a conifer stand, or it may cover an entire mountainside as a large stand or patch.

Available forage: That amount of growth of a vigorous and healthy plant that can be utilized as feed (regardless of what animal is using it) without impairing the plant's long-term health and productivity or other uses such as riparian filtering. The amount of available forage may be less where there is a need to restore health and vigor of forage plants. That amount may also depend on time of year and plant physiological stage, or other conditions such as drought.

Basal area: The common term used to describe the average amount of an area (usually an acre) occupied by tree stems. It is defined as the total cross-sectional area of all stems in a stand measured at breast height, and expressed as per unit of land area (typically square feet per acre).

Beneficial use: Any of the various uses which may be made of the water, including, but not limited to, domestic water supplies, fisheries and other aquatic life, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

Best management practices (BMPs) for water quality: Methods, measures or practices selected by an agency to meet its nonpoint source control needs. Best management practices for water quality include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Best management practices for water quality can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19).

Biocultural diversity: In this document, the diversity of plants, animals, insects, fungi and other natural and cultural resources found across the landscape that provide for the diversity of cultural and traditional uses, knowledge systems and practices of Native American Tribes.

California spotted owl protected activity center (PAC): An area established around an occupied California spotted owl site to help ensure successful reproduction and species viability. A protected activity center is approximately 300 acres in size and includes the best owl nesting and roosting habitat. Management in protected activity centers is limited except in the community wildfire protection zone where it is focused on reduction of surface and ladder fuels and includes retention of key habitat elements such as higher levels of basal area and canopy cover to provide the cool understory conditions owls need, and the down woody debris and forage (cover, fungi, seeds) needed by their prey. Management may involve limited thinning and/or burning to reduce the risk of high-intensity wildfire, often with timing restrictions to prevent disturbance to owls during the breeding season.

Candidate species: Candidate species are plants and animals for which the U.S. Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

Canopy: In a forest, the branches from the uppermost layer of trees; on rangeland, the vertical projection downward of the aerial portion of vegetation.

Canopy closure: The percentage of the sky hemisphere obscured by vegetation when viewed from a single point.

Canopy cover: The proportion of the forest floor covered by the vertical projection of the tree crowns (Jennings et al. 1999).

Cavity: The hollow excavated in a tree that is used by birds or mammals for roosting and/or reproduction.

CCF: Hundred cubic feet.

Class I airshed: An airshed classification where areas require the highest level of protection under the Clean Air Act of 1963.

Class II airshed: An airshed classification representing National Forest System land that is not classified as a Class I airshed. These areas may receive a greater amount of human-caused pollution than Class I areas.

Climate refugia: Locations where taxa survive periods of regionally adverse climate; locations that provide habitats for the long-term persistence of populations. These areas are relatively more buffered against climate change and climate-related disturbances than others. These refugia have resisted climate changes occurring elsewhere, often providing suitable habitat for relict populations of species that were previously more widespread.

Clump: A tight cluster of two or more trees that are generally of similar age and size, have adjacent or interlocking crowns, and share a common rooting zone.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the Federal Register (FR) by the executive departments and agencies of the Federal Government.

Complex early seral forests or habitat: Complex early seral habitat is a type of early successional forest habitat that develops following a stand-replacing event (e.g., high severity fire) and contains structural, compositional, or functional elements of ecological complexity or integrity. These elements may include biological legacies such as large snags, logs, and isolated live trees or tree clumps, as well as patches of young and diverse native shrubs, hardwoods, herbaceous plants, or tree regeneration. Other characteristic elements of complexity in early seral forests may include spatial heterogeneity in vegetation structure, diversity in vegetation composition, and variability in functional processes (e.g., nutrient cycling) during post-disturbance recovery.

Critical habitat: For a threatened or endangered species is**:** (1) the specific areas within the geographical area occupied by the species, at the time it is listed and in accordance with the provisions of section 4 of the Endangered Species Act (16 U.S.C. 1533), on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require special management considerations or protections; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. 1532 (3)(5)(A)). Critical habitat is designated through rulemaking by the Secretary of the Interior or Commerce (16 U.S.C.1533 (a)(3) and (b)(2)).

Coarse woody debris: Woody material, including logs, on the ground greater than 3 inches in diameter—a component of litter. Large coarse woody debris is often considered to be downed logs at least 12 inches in diameter and 8 feet in length.

Communications site: An area of National Forest System land used for telecommunications services. A communications site may be limited to a single communications facility, but most often encompasses more than one facility.

Community wildfire protection plans (CWPP): Plans for at-risk communities that identify and prioritize areas for hazardous fuels treatments. Several communities adjacent to the Inyo National Forest have developed these plans.

Connectivity: The ecological conditions that exist at several spatial and temporal scales to provide landscape linkages, including to**:** permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change.

Conservation Agreement or Conservation Strategy: Plans to remove or reduce threats to candidate and sensitive species of plants and animals so that a listing as threatened or endangered is unnecessary.

Consultation: (1) An active, affirmative process that (a) identifies issues and seeks input from appropriate American Indian governments, community groups, and individuals; and (b) considers their interests as a necessary and integral part of the Forest Service's decision-making process;
(2) the Federal government has a legal obligation to consult with American Indian Tribes. This legal obligation is based in such laws as the Native American Graves Protection and Repatriation Act, the American Indian Religious Freedom Act, and numerous other executive orders and statutes. This legal responsibility is, through consultation, to consider Indian interests and account for those interests in the decision;
(3) the term also refers to a requirement under section 7 of the Endangered Species Act (ESA) for Federal agencies to consult with the U.S. Fish and Wildlife Service with regard to Federal actions that may affect listed threatened and endangered species or critical habitat.

Cumulative effects or impacts: Cumulative effects or impacts are the impacts on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Effects and impact are synonymous (40 CFR 1508.7).

Desired condition: A desired condition is a description of specific social, economic, and/or ecological characteristics if the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. This description is specific enough to allow progress toward achievement to be determined but does not include a completion date.

Developed recreation site: A distinctly defined area where facilities are provided by the Forest Service for concentrated public use (campgrounds, picnic areas, and swimming areas).

Diameter at breast height (d.b.h.): The diameter of a forest tree species at the bole (or trunk) typically measured at 4.5 feet above ground level.

Dispersed recreation: Outdoor recreation in which visitors are spread over relatively large areas. Where facilities or developments are provided, they are more for access and protection of the environment than for the comfort or convenience of the visitors.

Ecological integrity: The quality or condition of an ecosystem when its dominant ecological characteristics (such as composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future condition.

Ecoregion: Ecoregion sections and subsections are units in the National Hierarchy of Ecological Units ranging in size from 13 million acres (section) down to 10,000 acres (subsection) that describe areas of similar environmental and biological features.

Ecosystem: A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its**:** (1) composition or the biological elements within the different levels of biological organization, from genes and species to communities and ecosystems; (2) structure or the organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern and connectivity; (3) function or the ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire and floods; and (4) connectivity.

Ecosystem diversity: The variety and relative extent of ecosystem types, including their composition, structure, and processes within all or a part of an area of analysis.

Ecosystem management: The use of an ecological approach to achieve multiple-use management of public lands by blending the needs of people and environmental values in such a way that lands represent diverse, healthy, productive, and sustainable ecosystems.

Ecosystem function (processes): The collective biotic processes of ecosystems and their effects on the physical and chemical conditions of their environment. These processes include nutrient cycling, plant primary production, decomposition, biotic interactions (such as food web interactions), carbon storage, hydrologic cycles, and soil respiration.

Ecosystem services: Benefits people obtain from ecosystems**:** (1) provisioning services, such as clean air and fresh water, energy, food, fuel, forage, wood products or fiber, and minerals; (2) regulating services, such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood and drought control; and disease regulation; (3) supporting services, such as pollination, seed dispersal, soil formation and nutrient cycling; and (4) cultural services, such as educational, aesthetic, spiritual, and cultural heritage values, recreational experiences, and tourism opportunities.

Ecosystem sustainability: The capacity of ecosystems to maintain ecological integrity, including ecosystem diversity, productivity, health, and resilience to stressors.

Eligible wild and scenic rivers: River segments that have been identified as eligible for inclusion in the national Wild and Scenic Rivers System under the authority of the Wild and Scenic Rivers Act. The river segment must be free-flowing and it must possess one or more outstandingly remarkable scenic, recreational, geological, fish and wildlife, historical, cultural, ecological or other value. See *wild and scenic rivers*.

Endangered species: Species that the Secretary of the Interior or the Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range. Endangered species are listed at 50 CFR sections 17.11, 17.12, and 224.101.

Endemic: Species or population that is limited in distribution to a specific geographic area.

Energy corridor: A linear strip of land identified for the present or future location of utility right-of-way (such as above or belowground electric transmission line, gas pipeline).

Energy development: Infrastructure associated with the provision or transport of energy (biomass power generation, wind turbines, and solar panels).

Environmental impact statement (EIS): A statement of the environmental effects of a proposed action and alternatives to it. It is required for major Federal actions under section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. A draft EIS is released to the public and other agencies for review and comment. A final EIS is issued after consideration of public comments. A record of decision is based on the information and analysis in the final EIS.

Environmental justice: To the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment.

Evapotranspiration: Loss of water from the earth's surface through evaporation from the soil and surface waterbodies and transpiration by plants.

Federal reserved water rights (reserved rights): When Congress designates Federal lands for a specific purpose it also reserves sufficient water to serve the purposes of that designation. These water rights are known as “Federal reserved water rights” or simply, reserved rights. Reserved rights are implied rights, meaning that Congress need not expressly state in a bill that it intends to reserve Federal water right. The right exists whether or not Congress explicitly mentions it.

Federally listed species: Threatened or endangered species listed under the Endangered Species Act, as amended. Candidate and proposed species are species which are being considered for Federal listing.

Fire intensity: The degree of energy and heat released from a fire.

Fire Management includes the entire scope of activities from planning, prevention, fuels or vegetation modification, prescribed fire, hazard mitigation, fire response, rehabilitation, monitoring and evaluation to meet land management objectives.

Fire regime: The long-term fire pattern characteristic of an ecosystem described as a combination of seasonality, fire return interval (length of time between fires), size, spatial complexity, intensity, severity, and fire type (e.g., surface fire, active crown fire). There are five fire regimes which are classified based on the fire return interval or frequency (average number of years between fires) and severity (amount of replacement of the dominant overstory vegetation) of the fire. These five regimes are**:**

- **Fire regime I:** 0- to 35-year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced)
- **Fire regime II:** 0- to 35-year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced)
- **Fire regime III:** 35- to 100+-year frequency and mixed severity
- **Fire regime IV:** 35- to 100+-year frequency and high severity
- **Fire regime V:** 200+-year frequency and high severity.

Fire regime condition class: A classification of the degree of departure from the natural fire regime. The fire regime condition class classification is based on a relative measure describing the degree of departure from the historical natural fire regime. This departure can result in changes (or risks) to one, or more, of the following ecological components**:** vegetation (species composition, structural stages, stand age, canopy cover, and mosaic pattern across the landscape); fuel composition; fire frequency, severity, and pattern; and other associated disturbances.

Condition class 1: Fire regimes are within the natural (historical) range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within the natural (historical) range.

Condition class 2: Fire regimes have been moderately altered from their natural (historical) range. Risk of losing key ecosystem components is moderate. Fire frequencies have departed from natural frequencies by one or more return intervals (either increased or decreased). This result in moderate changes to one or more of the following**:** fire size, intensity and severity, and landscape patterns. Vegetation and fuel attributes have been moderately altered from their natural (historical) range.

Condition class 3: Fire regimes have been substantially altered from their natural (historical) range. The risk of losing key ecosystem components is high. Fire frequencies have departed from natural frequencies by multiple return intervals. Dramatic changes occur to one or more of the following**:** fire size, intensity, severity, and landscape patterns. Vegetation attributes have been substantially altered from their natural (historical) range.

Fire restoration refers to the use of fire as a tool for restoration or the restoration of fire to the landscape within the historic fire return interval for the associated ecosystem.

Fire severity: Degree to which an ecosystem has been altered or disrupted by fire; also used to describe the product of fire intensity and residence time; commonly applied to vegetation or soils but may include other ecosystem components such as watersheds and wildlife. In this document, fire severity refers to vegetation burn severity unless otherwise specified.

Foliar: Pertaining to foliage (green tree leaves or needles).

Forest Service Handbook (FSH): Directives that provide detailed instructions on how to proceed with a specialized phase of a program or activity.

Forest Service Manual (FSM): A system of manuals that provides direction for Forest Service activities.

Fragmentation: The break-up of a large continuous land area by reducing and dividing into smaller patches isolated by areas converted to a different land type. Habitat can be fragmented by natural events or development activities. It is the opposite of connectivity.

Free-flowing: Water existing or flowing in natural conditions without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.

Fuel: Plants, both living and dead, and associated woody vegetative materials capable of burning.

Fuel load: The dry weight of combustible materials per unit area; usually expressed as tons per acre.

Fuels Management is the act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire, in support of land management objectives.

Fuel treatment: Any manipulation or removal of fuels to reduce the likelihood of ignition or to lessen potential damage and resistance to control.

Fuels reduction refers to the different tools used for treatments including fire, mechanical, or hand treatments to reduce fuels.

Fugitive dust: Fine particulate matter from windblown soil and dust which becomes airborne.

Geographic Information System (GIS): An information processing technology to input, store, manipulate, analyze, and display data; a system of computer maps with corresponding site-specific information that can be combined electronically to provide reports and maps.

Geomorphic: Refers to the process of erosion and sediment transport and deposition.

Global climate models (GCMs): Climate models are a mathematical representation of the climate. These models divide the earth, ocean and atmosphere into a grid. The values of the predicted variables, such as surface pressure, wind, temperature, humidity and rainfall are calculated at each grid point over time, to predict their future values. The GCMs used in the Fire-Climate section examined the expected change in large fire size with different future climate and vegetation restoration scenarios, and are defined below**:**

- **CCSM:** Community Climate system Model
- **GFDL:** Geophysical Fluids Dynamic Laboratory
- **CNRM:** Centre National de Recherches Météorologiques

Government-to-Government Consultation: The active and continuous process of contacting tribal leadership, soliciting their participation, involvement, comments, concerns, contributions, and traditional knowledge that will assist the agency in making informed decisions in planning, managing and decision-making actions.

Guideline: A guideline is a constraint on project and activity decisionmaking that allows for departure from its terms, so long as the purpose of the guideline is met. (§ 219.15(d)(3)). Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Habitat: A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

Hazard Tree Removal: The abatement of tree hazards, generally near roads, trails and facilities. Tree hazards include dead or dying trees, dead parts of live trees, or unstable live trees (due to structural defects or other factors) that are within striking distance of people or property (a target). Hazard trees have the potential to cause property damage, personal injury or fatality in the event of a failure.

Herbaceous: Plants lacking aboveground woody stems including grasses and forbs.

Herbivory: Loss of vegetation due to consumption by another organism.

Historic range of variation: See Natural Range of Variation.

Home range core area (HRCA): Areas established surrounding each territorial California spotted owl activity center detected after 1986. The core area amounts to 20 percent of the area described by the sum of the average breeding pair home range plus one standard error. For the Sierra National Forest, the home range core area size is 600 acres. Aerial photography is used to delineate the core area. Acreage for the entire core area is identified on national forest lands. Core areas encompass the best available California spotted owl habitat in the closest proximity to the owl activity center. The acreage in the 300-acre protected activity center counts toward the total home range core area. Core areas are delineated within 1.5 miles of the activity center. When activities are planned adjacent to non-national forest lands, 1.5-mile-circular core areas are delineated around California spotted owl activity centers on non-national forest lands. Using the best available habitat as described above, any part of the circular core area that lies on national forest lands is designated and managed as a California spotted owl home range core area.

Hydrologic: Refers to the movement, distribution, and quality of water.

Hydrologic function: The behavioral characteristics of a watershed described in terms of ability to sustain favorable conditions of waterflow. Favorable conditions of waterflow are defined in terms of water quality, quantity, and timing.

Hydrologic Unit Code (HUC): The U.S. is divided and subdivided into successively smaller hydrologic units (watersheds), which are identified by unique hydrologic unit codes (HUCs). The average size of a 4th level HUC watershed is 1 million acres, 5th level HUC watersheds are around 165,000 acres, and 6th level HUC watersheds are about 21,000 acres.

Hydrophytic vegetation: The sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present.

Instream flow: Seasonal stream flows needed for maintaining aquatic and riparian ecosystems, wildlife, fisheries, and recreation opportunities at an acceptable level.

Invasive species: Are alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health; species that cause, or is likely to cause harm and that is exotic to the ecosystem it has infested. Invasive species infest both aquatic and terrestrial areas and can be identified within any of the following four taxonomic categories**:** plants, vertebrates, invertebrates, and pathogens.

LANDFIRE: (Landscape Fire and Resource Management Planning Tools Project) is an interagency Program producing consistent and comprehensive data describing landscape change, disturbance, vegetation, fuel, and fire regimes across the United States.

Leasable minerals: Leasable minerals include coal, oil, gas, oil shale, sodium, phosphate, potassium, and geothermal. Leasable minerals also include the hardrock minerals, if they are found on lands that have "acquired" status. Leases are obtained through the Bureau of Land Management to extract these mineral resources.

Litter: Litter consists of dead, unattached organic material on the soil surface that is effective in protecting the soil surface from raindrop splash, sheet, and rill erosion and is at least ½ inch thick. Litter is composed of leaves, needles, cones, and woody vegetative debris including twigs, branches, and trunks.

Livestock grazing: Foraging by permitted livestock (domestic foraging animals of any kind).

Locatable minerals: In general, the hardrock minerals mined and processed for metals (gold, silver, copper, uranium, and some types of nonmetallic minerals such as sandstone). They are called "locatable," meaning subject to mining claim location under the United States mining laws. Locatable minerals are limited to lands with "reserved public domain" status.

Low-income population: Any readily identifiable group of low-income persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who would be similarly affected by USDA programs or activities. Low-income populations may be identified using data collected, maintained and analyzed by an agency or from analytical tools such as the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty.

Management practices (vegetation management practices): Silvicultural practices such as reforestation, prescribed fire, thinning to reduce stand density, and other practices designed to facilitate growth and development of trees.

Managing wildfires to meet resource objectives: A strategic choice to use unplanned wildfire starts to achieve resource management objectives and ecological purposes under specific environmental conditions. Such fires are monitored closely to ensure safe conditions for people, property, and other highly valued resources.

Meadows are classified based on multiple environmental factors that include: hydrology, vegetation, soil characteristics, geomorphology, physiography, altitude, and range type. Meadows are broadly defined as groundwater-dependent ecosystems composed of one or more herbaceous plant communities, where woody vegetation is often present, but not dominant. Meadows in the plan area include wetland areas; however, not all meadows are wetlands. Meadows fall along a hydrologic gradient of wet to dry. Peatlands are at the wettest end of this hydrologic spectrum, occurring primarily as fens in the plan area. Dry meadows occur in the most arid topographic positions and are primarily precipitation-dependent. In general, wet meadows tend to have lower amounts of bare soil compared to dry meadows that have a wider spacing of vegetation and more exposed soil.

Mechanical treatment: For the purposes of this analysis, mechanical treatments include most vegetation treatments except fire. They may include mechanical thinning, hand thinning, and other silvicultural treatments.

Mechanized travel/transport: Movement using any contrivance over land, water, or air, having moving parts, that provides a mechanical advantage to the user and that is powered by a living or nonliving power source. This includes, but is not limited to, sailboats, hang gliders, parachutes, bicycles, game carriers, carts, and wagons. It does not include wheelchairs when used as necessary medical appliances. It does not include skis, snowshoes, rafts, canoes, sleds, travois, or similar primitive devices without moving parts.

Minority: A person who is a member of one or more the following population groups**:** American Indian or Alaskan Native, Asian or Pacific Islander, Black, or Hispanic.

Minority population: Any readily identifiable group of minority persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who would be similarly affected by USDA programs or activities.

Motorized travel: Movement using machines that use a motor, engine, or other nonliving power sources other than a vehicle operated on rails or a wheelchair or mobility device, including one that is battery powered, designed solely for the use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area.

National Forest System (NFS): Includes national forests, national grasslands, and the National Tallgrass Prairie.

National Forest System road: A road wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources. A forest road other than a road which has been authorized by a legally documented right-of-way held by a state, county, or other local public road authority. (36 CFR 212.1)

National Forest System trail: A trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources A forest trail other than a trail which has been authorized by a legally documented right- of-way held by a state, county, or other local public road authority. (36 CFR 212.1)

National Wild and Scenic Rivers System: It was created by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations.

Natural Range of Variation (NRV): Spatial and temporal variation in ecosystem characteristics under historic disturbance regimes during a reference period. The reference period considered should be sufficiently long to include the full range of variation produced by the dominant natural disturbance regimes, often several centuries, for such disturbances as fire and flooding, and should also include short-term variation and cycles in climate. NRV is a term used synonymously with the historic range of variation. The NRV is a tool for assessing ecological integrity, and does not necessarily constitute a management target or desired condition. The NRV can help identify structural, functional, compositional, and connectivity characteristics, for which plan components may be important for either maintenance or restoration of such ecological conditions.

Nonmotorized travel: Movement not relying on machines that use a motor, engine, or other nonliving power source (walking, canoeing, and horseback riding).

Nonpoint source pollution: Refers to water pollution affecting water quality from diffuse sources, such as polluted runoff from agricultural areas draining into lakes, wetlands, rivers, and streams. Nonpoint source pollution can be contrasted with point source pollution, where discharges occur to a body of water at a single location, such as discharges from a chemical factory, urban runoff from a roadway or storm drain. Nonpoint source pollution may derive from many different sources with no specific solution to rectify the problem, making it difficult to regulate.

Objective: An objective is a concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives are based on reasonable foreseeable budgets.

Old forest: Old forests are characterized by the presence of large and old trees in the Sierra Nevada montane zone. Old forests vary widely based on forest type, soil type, topography, and fire history. Tree size is not necessarily related to tree age. Old forests often contain large snags and logs in addition to large live trees. The density and other structural features of these old forests vary widely.

Outstandingly remarkable value: A value that a river or river segment possesses that reflects its unique, rare, or exemplary qualities. In the Wild and Scenic River Act, river values identified include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Examples of other similar values include botanical, hydrological, paleontological, scientific, or heritage. A river must have at least one outstandingly remarkable value to be eligible for wild and scenic river designation.

Protected Activity Center: The areas that surround nest areas. They represent an area of habitat used for nesting and raising young until the time of leaving the nest.

Patch: Refers to a relatively homogeneous area that differs from its surroundings. Patches are the basic unit of the landscape that change and fluctuate. Patches have a definite shape and spatial configuration, and can be described compositionally by internal variables such as number of trees, number of tree species, age of trees, height of vegetation, or other similar measurements.

Planned ignition: A fire ignited by management actions under certain predetermined conditions to meet plan desired conditions. Prescribed fire is a synonymous term.

Planning period: The life of the plan, generally 10 to 15 years from plan approval. As a general rule, this analysis uses 10 years to define the planning period.

Primitive recreation: The reliance on personal, nonmotorized, or nonmechanized skills to travel and camp in an area, rather than reliance on facilities or outside help.

Recreation opportunity spectrum (ROS): Recreation settings allow a range of experiences to be achieved, from remote and challenging to easily navigated and supported by tourism services in surrounding communities. The recreation opportunity spectrum has six distinct classes in a continuum to describe settings that provide this range of experience, from highly modified and developed settings to primitive and undeveloped settings. The classes are**:**

Primitive (P): Characterized by essentially unmodified natural environment. Interaction between users is very low and evidence of other users is minimal. Essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is generally not permitted. Very high probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.

Semiprimitive Nonmotorized (SPNM): Characterized by a predominantly natural or natural-appearing environment. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum onsite controls and restrictions may be present, but are subtle. Motorized use is generally not permitted. High probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.

Semiprimitive Motorized (SPM): Characterized by a predominantly natural or natural- appearing environment. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on site controls and restrictions may be present, but are subtle. Motorized use is generally permitted. Moderate probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.

Roaded Natural (RN): Characterized by a predominantly natural-appearing environment with moderate evidence of the sights and sounds of other humans. Such evidences usually harmonize with the natural environment. Interaction between users may be low to moderate but with evidence of other users prevalent. Resource modification and utilization practices are evident but harmonize with the natural environment. Conventional motorized use is provided for in construction standards and design of facilities. Opportunity to affiliate with other users in developed sites but with some chance for privacy.

Roaded Modified (RM): Characterized by substantially modified natural environment except for campsites. Roads and management activities may be strongly dominant. There is moderate evidence of other users on roads. Conventional motorized use is provided for in construction standards and design of facilities. Opportunity to get away from others, but with easy access.

Rural (R): Characterized by substantially modified natural environment. Resource modification and utilization practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate densities are provided far away from developed sites. Facilities for intensified motorized use and parking are available. Opportunity to observe and affiliate with other users is important, as is convenience of facilities.

Urban (U): Characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of people onsite are predominant. Large numbers of users can be expected, both onsite and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site. Opportunity to observe and affiliate with other users is very important, as is convenience of facilities.

Reforestation: The natural or artificial reestablishment of an area with forest tree cover.

Research natural area: A physical or biological unit in which current natural conditions is maintained and can be observed. These conditions are ordinarily achieved by allowing natural physical and biological processes to prevail without human intervention. Research natural areas are principally for non-manipulative research, observation, and study. They are designated to maintain a wide spectrum of high quality representative areas that represent the major forms of variability found in forest, shrublands, grassland, alpine, and natural situations that have scientific interest and importance that, in combination, form a national network of ecological areas for research, education, and maintenance of biological diversity.

Resilience: The ability of an ecosystem and its component parts to absorb, or recover from, the effects of disturbance through preservation, restoration or improvement of its essential structures and functions, and redundancy of ecological patterns across the landscape.

Restoration: See ecological restoration.

Riparian area: Include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths.

Riparian Conservation Areas: An area of vegetation or forest litter located adjacent to stream courses and/or riparian areas for the purpose of filtering sediment, providing bank stability, and providing shade for fisheries habitat in tree/shrub ecosystems.

Road maintenance: The upkeep of the entire transportation facility including surface and shoulders, parking and side areas, structures, and such traffic control devices as are necessary for its safe and efficient utilization (36 CFR 212.1). This work includes brushing of roadside vegetation, falling danger trees, road blading, cleaning ditches, cleaning culvert inlets and outlets, etc.

Sacred sites: Defined in Executive Order 13007 as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian Tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the Tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site."

Scenic integrity objectives– In the context of the forest plan are equivalent to goals or desired conditions. Scenic integrity describes the state of naturalness or a measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the landscape character valued by constituents for its aesthetic quality. Scenic integrity is the state of naturalness or, conversely, the state of disturbance created by human activities or alteration. Scenic integrity is measured in five levels**:**

- **Very high:** landscapes where the valued landscape character "is" intact with only minute, if any deviations. The existing landscape character and sense of place is expressed at the highest possible level.
- **High:** landscapes where the valued landscape character appears unaltered. Deviations may be present but must repeat the form, line, color, texture and pattern common to the landscape character so completely and at such scale that they are not evident.
- **Moderate:** landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.
- **Low:** landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect, pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed, but compatible or complimentary to the character within.
- **Very Low:** landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect, pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However, deviations must be shaped and blended with the natural terrain so that elements such as unnatural edges, roads, landings and structures do not dominate the composition.

Scenic character - is defined as the combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity.

Scenic stability - Scenic stability measures the degree to which the scenic character and its scenery attributes can be sustained through time and ecological progression. In other words, it looks at the ecological sustainability of the valued scenic character and its scenery attributes. Because attributes such as rock outcroppings and landforms change relatively little over time, scenic stability focuses on the dominant vegetation scenery attributes. It recognizes the often subtle, incremental changes that can severely diminish or eliminate scenic character.

Scoping period: The time during which a proposed action has been provided to the public for review and comment so that the scope of issues related to the proposed action can be determined.

Seral stage: A particular plant and animal community developmental stage which is transitional between other stages along the continuum of succession or change. Following disturbance, ecological communities often undergo directional change in composition and structure over time from early to late seral stages through localized, successional processes. . Early seral forest is an example of a seral state that, without disturbance over time, will eventually transition to a subsequent seral state dominated by mid-sized conifers.

Silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands using species silvics to meet the diverse needs and values of landowners and society on a sustainable basis.

Slash: The residue (such as branches or bark) left on the ground after a management activity, such as logging, or natural ecological process such as a storm or fire.

Snags: Standing dead or partially dead trees (snag topped), often missing many or all limbs and/or bark. Snags (generally 12 inches or larger) provide essential wildlife habitat for many species and are important forest ecosystem structures.

Soil productivity: The inherent capacity of the soil to support appropriate site-specific biological resource management objectives, which includes the growth of specified plants, plant communities, or a sequence of plant communities to support multiple land uses.

Special use authorization: A permit, term permit, temporary permit, lease, easement, or other written instrument that grants rights or privileges of occupancy and use subject to specified terms and conditions on National Forest System land.

Stand: A contiguous group of trees sufficiently uniform in age class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit, such as mixed, pure, even-aged and uneven-aged stands.

Standard: A standard is a mandatory constraint on project and activity decisionmaking, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

Standard terra trails: Trails that have a surface consisting predominantly of the ground and are designed and managed to accommodate use on that surface. They do not include snow or water trails.

Structure: Structure includes both the vertical and horizontal dimensions of a vegetation type or plant community. The horizontal structure refers to spatial patterns of individual and groups of plants and openings, as well as plant size and species composition. The vertical component refers to the layers of vegetation between the forest floor and the top of the canopy. Each vegetation type has its own structure. For example, forests have greater vertical structure than a grassland or woodland based on the height of the dominant species.

Suitable timberlands: Land to be managed for timber production on a regulated basis. Such lands are those which have been determined to meet the following criteria**:** (a) are available for timber production (not withdrawn for wilderness or other official designation by Congress, the Secretary of Agriculture, or Chief of the Forest Service); (b) are physically capable of producing crops of industrial wood without irreversible resource damage to soils productivity or watershed conditions; (c) adequate tree restocking within 5 years of final harvest is reasonably assured; (d) adequate information exists about responses to timber management activities; (e) timber management is cost efficient over the planning horizon in meeting forest objectives that include timber production; (f) timber production is consistent with meeting the management requirements and multiple-use objectives specified in the forest plan or plan alternative; and (g) other management objectives do not limit timber production activities to the point where it is impossible to meet management requirements set forth in 36 CFR 129.27 (per Forest Service Handbook 2409.13, WO Amendment 2409.13-92-1, O Code and Chapter 20).

Suitability of Lands: The suitability of lands is determined for specific lands within the plan area. The lands are identified as suitable or not suitable for various uses or activities based on desired conditions applicable to those lands. The suitability of lands is not identified for every use or activity. Every plan must identify those lands that are not suitable for timber production (§ 219.11).

Sustainability: The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For the purposes of the land management planning regulation at 36 CFR part 219, ecological sustainability refers to the capability of ecosystems to maintain ecological integrity; economic sustainability refers to the capability of society to produce and consume or otherwise benefit from goods and services, including contributions to jobs and market and nonmarket benefits; and social sustainability refers to the capability of society to support the network of relationships, traditions, culture and activities that connect people to the land and to one another, and support vibrant communities.

Sustainable recreation - the set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations.

Thinning: An intermediate treatment made to reduce the stand density of trees primarily to improve growth, enhance forest health, to recover potential mortality, or to emphasize desired tree species. Includes crown thinning (thinning from above, high thinning), free thinning, low thinning (thinning from below), mechanical thinning (geometric thinning), and selection thinning (dominant thinning). Thinning can be used with both even and uneven-aged management systems.

Timber production: The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19).

Total maximum daily load (TMDL): A TMDL is a written analysis that determines the maximum amount of a pollutant that a surface water can assimilate (the "load"), and still attain water quality standards during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background levels and seasonal variation, with an allocation set aside as a margin of safety.

Traditional cultural properties (TCP): Defined in National Register Bulletin 38 as properties associated "with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community." TCPs can range from structures, mountains, and other landforms to plant gathering locations to communities. These areas are considered historic properties that may be eligible to the National Register of Historic Places

Travel Management Rule (November 29, 2005, 36 CFR 212.51)**:** requires that each national forest designate a system of roads, trails, and areas for motor vehicle use by vehicle class and, if appropriate, by time of year. Once the system is designated, the rule will prohibit motor vehicle use off the designated system.

Unauthorized road or trail: A road or trail that is not a forest road or trail or a temporary road or trail and that is not included in a forest transportation atlas (36 CFR 212.1, Forest Service Manual 2353.05, and Forest Service Manual 7705).

Uncharacteristic wildfire: Refers to wildfire that exceeds the natural range of variation in fire severity (high severity proportion, high severity patch size) and other fire effects indicators for a specific vegetation type[61].

Undesirable wildfire: Wildfire that does not meet the desired conditions for a specific vegetation type.

Unplanned ignition: A wildfire, not including planned ignitions.

Vegetation Burn Severity: The degree of vegetation mortality caused by a fire and the fire severity from the ecological effect of the fire. As used in this Forest Plan, refers to the effect of the fire on the dominant vegetation, which are coniferous trees. Three levels of fire severity are recognized**:**

- High severity**:** greater than 75 percent of the dominant overstory vegetation (trees) are killed. Also referred to as stand-replacement fire.
- Moderate severity**:** 25 to 75% of the dominant overstory vegetation (trees) are killed.
- Low severity**:** less than 25% of dominant overstory vegetation (trees) are killed.

Wild and scenic river: A river designated by Congress as part of the National Wild and Scenic Rivers System that was established in the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 (note), 1271–1287).

- **Wild:** Those rivers or sections of rivers free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
- **Scenic:** Those rivers or sections of rivers free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
- **Recreational:** Those rivers or sections of rivers readily accessible by road or railroad that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

[61] Hardy, C. C. 2005. Wildland fire hazard and risk: Problems, definitions, and context. Forest ecology and management, 211(1), 73-82.

Wildland-urban intermix (WUI): Includes those areas of resident populations at imminent risk from wildfire, and human developments having special significance. These areas may include critical communications sites, municipal watersheds, high voltage transmission lines, church camps, scout camps, research facilities, and other structures that if destroyed by fire, would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved (Forest Service Manual 5140.5).

Xeric: Very dry region or climate; tolerating or adapted to dry conditions. Dry soil moisture regime. Some moisture is present but does not occur at optimum levels for plant growth.

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