NATIONAL FORESTS IN THE SIERRA NEVADA:

A CONSERVATION STRATEGY

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Preparation

This strategy was developed by a team of scientists and resource specialists from a variety of conservation organizations. The following individuals led the literature review and synthesis and worked with colleagues to develop the recommendations for specific topic areas.

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INTRODUCTION TO THE CONSERVATION STRATEGY

OVERVIEW

California is the most biologically diverse state in the nation. Compared to other states, California has the greatest number of plant species and the most endemic species – plants and animals that occur only in California. The California Floristic Province, which includes the Sierra Nevada, has been designated as a global biodiversity hotspot by Conservation International, The Nature Conservancy and the World Wildlife Fund. Floristic diversity in the California Floristic Province is highest in the Sierra Nevada and Transverse ranges (Richerson and Lum 1980). The rich biological diversity and high endemism are the result of adaptation and evolution in response to the highly varied topography, climate zones, fire regime, geology, and soils found in the Sierra Nevada. The region contains one of the most biologically diverse temperate conifer forests on the planet, with 27 different species of conifers and over 3,000 vascular plants, 400 of which only occur in the Sierra Nevada (Centers for Water and Wildland Resources 1996). About 300 species of terrestrial vertebrates, including mammals, birds, reptiles, and amphibians use the Sierra Nevada as a significant part of their range, with an additional 100 species occupying the bioregion as a minor part of more extensive ranges elsewhere (Id.).

One hundred thirty-five plant species and sixty-nine terrestrial vertebrate species found predominantly in the Sierra Nevada are considered at risk by state or federal agencies (Id.). These species are threatened by a variety of stressors – California's rapid pace of development, habitat loss, habitat degradation, new pathogens, competition from introduced invasive species, and disruption of essential ecological processes such as fire. The additional stress from expected changes in future climate and the synergy among stressors are likely to affect the Sierra Nevada bioregion in ways not previously anticipated.

Land management planning on national forest lands in the Sierra Nevada offers a critical opportunity to define biologically appropriate protection and restoration strategies in this diverse region. With approximately 40 percent of the region comprised of national forest lands, the Forest Service is the largest land manager and oversees eleven national forests covering approximately 11.5 million acres. Thoughtful and forward thinking planning has the potential to positively influence a significant portion of the region. It is also timely to undertake a comprehensive review of biological resources in the region. Management activities on national forest are governed by their respective forest plans. The forest plans are intended to have a life time of about 15 years. The forest plans for the national forests in the Sierra Nevada were first adopted in the mid to late 1980s. Collectively, these forest plans have been amended three times since first adopted, and they are now ripe for a thorough review and revision. Forest Service leadership is in agreement with the need to revise the forest plans. The agency, in July 2012, released a draft revised forest plan for the Lake Tahoe Basin Management Unit and began in 2012 the process to revise three other forest plans (Inyo, Sierra, and Sequoia national forests). The Forest Service has adopted an ambitious schedule to revise a forest plan within three years of initiating the process.

In anticipation of the public dialogue about forest planning, our coalition developed the following conservation strategy for the national forests in the Sierra Nevada. The purpose of the strategy is to identify issues we believe to be a high priority to address during the process of revising forest plans and to suggest specific tools, methods, or actions to resolve or address these issues.

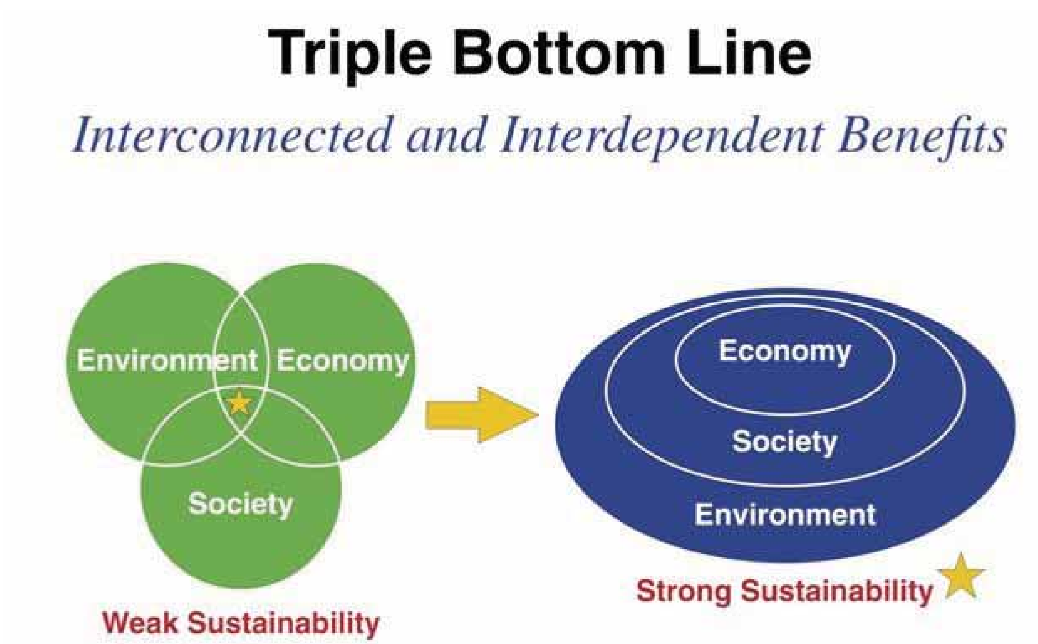
Our Founding Principle: Ecological Sustainability

The concept of sustainability is central to any discussion of resource management (Orr 2002). The term generally suggests positive value in our culture, yet sustainability holds a highly variable meaning within various interest groups. While there is no universally agreed upon definition of sustainable management, the term is used widely throughout the world to support the need for improved management.

Commonly, the culture of resource management depicts decisions in a framework of social, economic and ecological choices framing the land manager's decision space. Such "three-legged stool" characterizations perpetuate the myth that humanity is outside the biological system versus limited by it (Dawe and Ryan 2003). The discipline of conservation biology correctly argues that we are biological organisms living in a biologically defined and limited planet. The ecosystem is the foundation upon which social structures and economic systems are built, and while important, social and economic structures do not exist as co-equal with ecological needs. Rather, social and economic structures must fit within the biological system. This view has been characterized by Hart (1999), USDA Forest Service (2010) and others as strong sustainability. Strong sustainability "acknowledges that the human economy depends on people and social interaction. Society, in turn, cannot exist outside the environment which provides the basic necessities for people to exist: air, food, water, energy, and raw materials" (USDA Forest Service 2010).

Our values, in a broad sense, have been recorded in mottos such as "the greatest good for the greatest number in the long run" and "caring for the land and serving people," and in the Forest Service mission statement: "Sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." What's missing is an understanding of the impossible demands of an overgrown population on a finite resource base—the American wildlands are in retreat, largely degraded and lack resilience due to unfettered economic demands and, until recently, the absence of enlightened ecological thinking.

Figure I-1. Weak versus Strong Sustainability. Adapted from USDA Forest Service (2010).



Sustainable growth is often confused with sustainable development. Based upon current levels of global climate stress, loss of wetlands, air and water pollution, and species extinctions, sustainable growth is clearly an oxymoron. Sustainable human cultures may still be a possibility if societies can grasp the need for what Orr (2002) calls a "graceful transition" to a downsized economy operating on renewable resources and with a shared understanding about the use of public trust resources such as water, air, soil, and wildlife.

We adopt in this conservation strategy the definition of ecological sustainability proposed by Callicott and Mumford (1997): "meeting human needs without compromising the health of ecosystems." This definition is compatible with the goals of biological conservation and appropriately frames human demands on the ecosystem. A goal of this conservation strategy is to support sustainable management decisions that are firmly grounded on science-based ecological principles and that recognize the inherent value of the landscapes that contain the structures, composition and processes that support and enhance biodiversity, heterogeneity and complexity.

The primary focus of this strategy is to identify actions that protect and restore biological values on national forest lands in the Sierra Nevada. We also recognize that people work and recreate in and around national forest lands and require a safe environment for these pursuits. There may be instances where actions to accomplish protection and restoration also address public safety; however, we do not always expect this to be the case. In those instances where public safety requires actions that are not based on protection and restoration, those actions that we propose to address public safety will be ecologically sustainable.

Climate Change and Other Stressors

The effect of humans on the Sierra Nevada ecosystems has been wide ranging for more than 150 years. Consumption and use of various resources (e.g., water, minerals, timber, forage) combined with patterns of human development and recreation have altered the composition, structure and function of the ecosystem. Climate change has become an emergent stressor that interacts with other demands that have been placed on ecosystems. This conservation strategy was designed to identify existing stressors, consider how they interact with each other, and propose actions to reduce the stress. The result of this approach is that actions to ameliorate the effects of a changing climate on important characteristics of the ecosystem (e.g., at-risk species, disturbance processes) are integrated into each section where appropriate. There is no single section for the conservation strategy that focuses on climate change as a stressor since its effect, along with other stressors, is pervasive. We promote in this conservation strategy several actions to ameliorate and adapt to the effects of climate change including:

- Assessing risk and vulnerability of key attributes or elements,
- Reducing fragmentation of habitat,
- Identifying climate refugia and other reserved areas,
- Reintroducing disturbance processes,
- Limiting the disruption of essential cycles (e.g., hydrologic cycle),
- Reducing other human induced stress resulting from over consumption or habitat degradation,
- Integrating science into management as the basis for future adaptation to management.

These actions commonly are recommended in the literature as "climate smart" approaches to management in a changing environment (Heller and Zavaleta 2009; USDI Fish and Wildlife Service 2010) and focus on increasing the ability of the system to adapt to change. We also address to a limited extent mitigations to reduce the demand for carbon or support carbon storage. The actions proposed to develop local economies for the use of wood products can lead to a reduction in transportation costs. We also propose actions that we expect will create resiliency in the ecosystem and provide for carbon storage that fluctuates with desired levels of disturbance. The storage and emission of carbon is an essential process in forest systems and is especially important in fire dependent systems. Carbon is a fundamental building block in the creation of structure and habitat. The goal of this conservation strategy is to restore structure, composition and process to forest systems. Carbon as a reserve to provide mitigation or offsets for greenhouse gas production is viewed as a collateral benefit of a functioning forest ecosystem and does not drive restoration objectives.

DESIGN OF THE CONSERVATION STRATEGY

The conservation strategy is designed to address the role of structure, composition, and process of the ecosystems in the Sierra Nevada. Our goal is to design conservation actions integrated across scales in time and space that address our concerns about species at risk, disrupted cycles of disturbance, and other impacts of human activity on the landscape.

Each of the following sections follows a similar format. One to several issue areas are addressed in each section. Each issue area includes a statement that frames current trends and opportunities and proposes conservation actions to address concerns. The conservation actions are designed to be applied in one of four different types of decision making settings:

- Revising a forest plan,
- Decisions at the national forest level not directly addressed in a forest plan,
- Decisions made at the regional level of the Forest Service, and
- Decisions or actions undertaken by other agencies or groups.

The conservation actions defined for a forest plan revision specifically address the desired conditions, objectives, land allocations, and standards that we recommend for inclusion in the revised forest plans for the Sierra Nevada. We view the desired conditions, objectives, land allocations, and standards as elements common to any plan; they provide direction and set priorities for action. We define these planning elements in the following way:

> **Desired Conditions:** These statements describe the nature of the future environment that is desired. They are focused on conditions that the forest plan can influence.
>
> **Objectives:** These are the specific state or condition to be achieved within the time frame of the plan. The objectives are linked to the achievement of the desired conditions.
>
> **Land Allocations:** These are areas to which specific management direction and priorities have been assigned. These are also referred to as management areas.
>
> **Standards:** These are practices or project design criteria that must be met or applied when developing and implementing projects.

Conservation measures have also been identified for a number of species at risk. Accounts for these species and the proposed conservation measures are located in Appendix A. These species accounts and conservation measures are referenced in various sections of the conservation strategy that address habitat issues for these species.

USE OF THE CONSERVATION STRATEGY THROUGHOUT THE FOREST PLAN REVISION PROCESS

The forest plan revision process will take several years to complete for all national forest in the Sierra Nevada. We also expect that new information will become available about resources in the Sierra Nevada during the period in which revisions are occurring. To accommodate the anticipated need to update information, we designed the strategy in sections that can be updated independently or as a group. A revision date is noted on the footer of each page and will be changed following any revisions. This version and future revisions of the strategy will be available on the Sierra Forest Legacy website (www.sierraforestlegacy.org) along with additional background information or recommendations for specific national forests when available.

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PEOPLE AND THE SIERRA NEVADA

ISSUE STATEMENT

Humans have traveled through and lived in the Sierra Nevada for centuries. The early influence of native Californians on fire patterns and the translocation of plants has been documented (Anderson and Moratto 1996). With the arrival of European settlers, interests in mining, timber, livestock grazing, and water development were established and the land further shaped by the demands placed on it. Today, humans live in, make a living from, recreate in and seek solace from the Sierra Nevada ecosystem. There is little dispute that humans have altered the Sierra Nevada environment in ways that are not sustainable. The demands on water for consumptive uses and the suppression of fire are just two examples of the ways that humans have impeded essential cycles and processes in the name of deriving social and economic benefits.

Our goal is to live in balance with the Sierra Nevada ecosystem and not at its expense. To that end, we adopt in this conservation strategy the principle that land management will be designed to meet "human needs without compromising the health of ecosystems" (Callicott and Mumford 1997).

Public Safety

People live, work and recreate within and adjacent to national forest lands in the Sierra Nevada. Our challenge is to design ways for people to safely enjoy the outdoors and benefit from forest resources while protecting and restoring the health of the ecosystem.

One of the most prevalent public safety concerns is related to wildfire. The protection of life and property is often foremost in the minds of those who live and work in the Sierra Nevada. It is the responsibility of the community as a whole to provide for a safe environment. Individual land owners and managers, including the Forest Service, are responsible for maintaining a fire resilient environment near their structures and including the structures themselves. Forest roads necessary for egress during emergencies also need to be maintained in a fire resilient condition that allows passage. Recreationists, forest workers, and other forest visitors also are responsible to conduct their activities in ways that are fire-cautious and that do not introduce fire risk into the environment.

Forests, Woodlands, and Shrublands

Our goals for this fire dependent ecosystem include the restoration of characteristic and resilient ecological conditions through the re-introduction of fire at appropriate scales and intensities across significant portions of the Sierra Nevada. To accomplish this goal, we recognize that the mechanical removal of vegetation prior to the application of managed fire will likely be necessary in some landscapes. Mechanical removal of vegetation needs to be carefully designed to remove the vegetation necessary for reducing risk while retaining sufficient habitat structure and diversity to support healthy wildlife populations. Further, we promote the maintenance and development of the necessary infrastructure designed to remove wood fiber, such as biomass and small diameter wood, to achieve our restoration goals. We support the creation of infrastructure to process wood fiber that also supports the removal of biomass in a manner that is ecologically sustainable. It is critical that the capacity of the infrastructure fit the pace and scale of the restoration need and for the infrastructure to adjust to ecosystem needs – not drive or override them.

Rangelands

Rangelands include a variety of vegetative communities, e.g., aspen, montane meadows, shrubland, and oak woodland. Aspen habitat, meadow and riparian areas encompass some of the most ecologically important habitats in the Sierra Nevada and have been significantly degraded by historic and contemporary grazing programs and other activities (Kattelmann 1996; Moyle 1996).

The current health of these systems needs to be carefully evaluated. Management practices need to be designed and applied to restore degraded systems and maintain or enhance healthy systems. Further, restoration plans that target these plant communities need to alleviate the full range of stressors, including overgrazing and other human impacts where present.

Water Resources

People throughout California depend on the high quality water originating in the Sierra Nevada. It has been estimated that 65 percent of the water used in California comes from this region (Timmer 2003). Water that passes through the region is used locally and downstream for consumptive use and to generate hydro-electric power. The cycle of dry and wet years common to California has always presented a challenge to water planning in the State. The anticipated changes in temperature and precipitation due to human induced climate change are certain to exacerbate the conflicts.

The water needs of people place demands on aquatic and hydrologic systems that are already highly taxed. The Sierra Nevada Ecosystem Project (SNEP) concluded that “aquatic/riparian systems are the most altered and impaired habitats of the Sierra” (Centers for Water and Wildland Resources 1996, p. 8). Further, SNEP found that water quality in the Sierra Nevada was negatively affected by excessive sediment, restricted water flow, and chemical contamination.

Providing for the health of the Sierra Nevada ecosystem will require communities, resource managers, scientists, and conservation interests to work together to build a conservation and restoration economy that is ecologically sustainable and “tooled” to protect and restore ecosystem health while avoiding more harm.

POLICY ACTIONS NEEDED

The following policy actions are designed to provide administrative and planning support to enhance the ability to use small diameter wood products, to support local processing and use of products, and to engage communities of interest and place in the management of national forests. These actions are intended to improve our ability to utilize natural resources at a pace and scale that is in balance with the ecosystem. Measures important to the protection of specific resources are noted elsewhere in this conservation strategy, e.g., management direction pertaining to timber harvest is noted in several sections relating to the management of old forests, species at risk, aquatic management, and more.

Proposal for Revision to Forest Plan Direction

A. Desired Condition. *The following statements represent the desired future condition of the administrative setting or landscape and may not reflect the current conditions.*

Desired Condition ES-1. Projects are designed to be ecologically sustainable with respect to both the effect on the environment from removing forest products, and the utilization or processing of the product. Products or ecosystem services include resources such as wood fiber, minerals, livestock forage, and water.

Desired Condition ES-2. Projects providing wood fiber incorporate design elements, such as processing areas for biomass or material sorting, to provide opportunities to utilize or process materials on-site or in adjacent communities.

Desired Condition ES-3. Projects are developed that utilize wood fiber locally in support of local wood processing efforts and community-based restoration.

Desired Conditions ES-4. Landscapes provide ecosystem services such as water storage, water filtration, soil regeneration, biodiversity, stable and resilient carbon pool, and resilience to drought, insect and disease that are outside the range of natural variability.

B. Objectives

Objective ES-1. By the fifth year following adoption of the plan, fifty percent or more of the projects proposed by a national forest to generate wood products are designed for local wood processing opportunities.

Objective ES-2. A Wood Products Working Group, whose charge is to support local wood processing efforts, is established within two years of the adoption of the forest plan.

Objective ES-3. Restoration plans have been developed within five years of adoption of the plan for rangelands that are not in the desired ecological condition.

Objective ES-4. The length of time between timber harvest-related disturbance is increased in the next 10-15 years to ensure carbon is stored in ecosystem stocks for longer periods of time.

C. Standards

Standard ES-1. Land allocations identify, generally or specifically, areas appropriate for processing biomass or wood fiber sorting.

Standard ES-2. Projects promoting the use of biomass as a renewable energy source must undergo a cradle-to-grave carbon footprint analysis, including so-called "indirect" effects, i.e., the impacts caused as worldwide markets adjust to increased biomass harvesting.

Standard ES-3. Apply fire-resistant building standards and practices for buildings permitted under special use permits or for buildings maintained by the Forest Service.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Forest Service and community scale partnerships should focus on biomass-to-thermal uses as a priority. Proposed electric or combined heat and power generating facilities should be no larger that 3 mega-watts and capacity should be based on appropriate criteria for economic and ecological sustainability.

- District Ranger and Forest Supervisor offices should utilize local densified wood products (e.g., wood pellets, "bricks" or shavings) to support their operations when feasible within the next 5 years

- Leadership at the forest-level should support collaborative community involvement to ensure the success of processing small diameter materials locally.

- Projects providing forest products should incorporate design elements, such as processing areas for biomass or material sorting, to provide opportunities to utilize or process materials on-site.

- Use the Wood Products Working Group for each national forest to develop information and resources to utilize in designing local projects. For example:

  Identify project design features important to the successful processing of forest products locally or on-site,
  Provide a survey of businesses that process small diameter wood products locally and characterize their customer base,
  Identify the opportunities for assistance and collaboration in the use of small diameter materials for local projects, including public service and work programs, youth corps, and other local partners.

Recommendations for New Regional Direction or Policy

- Create a Wood Products Working Group at the regional level to support the work of the working groups associated with each national forest.
- Promote programs (e.g., assistance grants, regional and national funding sources) and opportunities (e.g., community partnerships, stakeholder interest) that could facilitate the use of small diameter wood products.
- Provide examples of successful partnerships among the Forest Service, businesses, and communities that supported development of programs to process and utilize wood products locally.

Additional Recommendations

- Improve wildfire preparedness by using the Firewise Communities program (http://www.firewise.org/) to educate and mobilize forest communities to prepare and plan for wildfire.

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PLANNING PROCESS AND INTEGRATION

ISSUE STATEMENT

The management issues facing national forests in the Sierra Nevada – which include protecting habitat for wide-ranging species, conserving water resources flowing through multiple watersheds, and restoring natural disturbance processes such as fire to the ecosystem – are complex and interrelated. Furthermore, many stressors that strongly influence this region as a whole, such as climate change and the disruption of fire as an ecological process, do not adhere to jurisdictional boundaries. Effective management of the Sierra Nevada ecosystem requires a holistic approach that informs and is informed by the management and needs of individual forest system units up and down the range. The conservation of ecosystems and their processes at the landscape level must be the goal. As noted by past Forest Service Chief, Jack Ward Thomas:

> We must learn to prevent the creation of threatened species rather than performing heroic management feats to pull species back from the brink of extinction.[1]

This wisdom applies equally to issues of forest resilience, watershed health, and other resource concerns. Indeed, as Secretary Vilsack recently emphasized, the U.S. Fish and Wildlife Service is focused on "threats to wildlife habitat due to fragmentation and climate change," and meeting these threats will require "landscape conservation action plans" that extend across ecoregions.[2]

Planning for a landscape as large as the Sierra Nevada requires considering issues at multiple scales. Some issues are best dealt with on a regional level or national forest level, others at the watershed level, and still others at the site-specific level. Successful management will require integrating communication and planning among these scales and across jurisdictions and ownerships. Elements that are critical to effective coordination include:

- Communication and management frameworks that support integrated planning within and across jurisdictional boundaries;
- Open information transfer and exchange among the science community, resource specialists, managers, and other stakeholders that is timely, transparent and focused on resolving resource conflicts; and
- Management direction to ameliorate stressors, including climate change, and that coordinates with, complements and builds upon the actions of other agencies.

Effective management of the national forests in the Sierra Nevada depends on the implementation of practices supported by science and scientific principles. This view is reflected in the direction President Obama set early in his administration regarding the important role of science in guiding agency policy-making, in which he stated:

> Science and the scientific process must inform and guide decisions of my Administration on a wide range of issues, including improvement of public health, protection of the environment, increased efficiency in the use of energy and other resources, mitigation of the threat of climate change, and protection of national security. The public must be able to trust the science and scientific process informing public policy decisions.[3]

[1] Thomas, J. W. 1993. Forest management approaches on public lands. Albright lecturer speech. University of California, Berkeley.
[2] Letter from Secretary Tom Vilsack to Mr. Greg Costello, Western Environmental Law Center (Jan. 26, 2010).

[3] Presidential Memorandum on Scientific Integrity for the Heads of Executive Departments and Agencies, March 9, 2009, http://www.whitehouse.gov/the_press_office/Memorandum-

The involvement of scientists early in any planning process, the development of a process for continuous review and application of the pertinent scientific research, and the integration of science consistency reviews at critical stages of the planning process are steps that can ensure the appropriate application of science to planning and management on national forests in the region.

Land management planning has become increasingly complicated in the face of climate change and the synergistic effects of other stressors. Researchers have noted shifts in animal migration, plant blooming dates (Bradley et al. 1999), as well as the intensity of fires and floods. Biotic communities are likely to be reassembled in new ways with novel predator, prey and competitive interactions (Stralberg et al. 2009). Thus, the objectives of maintaining and restoring ecosystem health are challenged in new ways.

Well-structured scientific input is necessary to address environmental challenges and critical issues affecting national forests, including climate change, ecosystem restoration, maintenance of ecological services, and wildlife viability. Key to the effective use of science will be the integration of science and scientists from a variety of disciplines and agencies early in the process to assist planning staff and collaboration partners in building strong regional direction. The integration of fire ecology, climate science, conservation biology, forest ecology and aquatic ecology, along with inclusion of third-party scientists will be critical to a well grounded approach to management.

The integration of collaboration in land management decision making also will be critical to successful management. Effective collaboration requires training, clarity of purpose and roles, and transparency. This approach to planning should also be supported through performance measures that reward collaboration. The agencies should continue to emphasize the importance of collaboration and provide the training to do it effectively (Vosick et al. 2007). The science-based collaboration efforts guided by the Center for Collaborative Policy, currently ongoing in Region 5, are examples of professionally structured collaborative efforts that set high standards for both social and scientific interaction within collaborative groups.

The actions below are designed to increase effective communication, coordination, and planning within the Forest Service and between the Forest Service and other jurisdictions and stakeholders for the benefit of both national forest lands and the Sierra Nevada landscape as a whole. The actions also address the importance of integrating science and scientists into the planning process.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the administrative setting and may not reflect the current conditions.*

Desired Condition PLAN-1. Communication and management frameworks support integration of management across national forests, among ranger districts, and between forests and surrounding land users, managing agencies, scientists, and governments.

Desired Condition PLAN-2. Information and research plans flow smoothly among project planners, specialists, and decision makers and are used to design projects and support management decisions.

Desired Condition PLAN-3. Resource planning is completed at a scale appropriate to the issue at hand. Clear direction results in analyses that are completed in an efficient manner, focused on the relevant issues, and integrated across multiple planning scales.

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Desired Condition PLAN-4. Regional and watershed scales of planning require cooperation across national forest boundaries. Cooperative planning efforts between national forests improve the efficiency of the planning process and more effectively address restoration goals. For many issues, cooperative planning among the national forests is the only course capable of achieving the restoration goals established by the Regional Office.

Desired Condition PLAN-5. Variations in management practices across the Sierra Nevada are based on the fundamental differences in the ecosystem characteristics for specific planning areas and are not a result of differing interpretations of the planning direction issued by the Regional Office or contained in forest plans.

B. Objectives

Objective PLAN-1. A Forest Integration Team is established within one year of adoption of the forest plan. This team is charged with providing an annual evaluation of the ecological integration of projects undertaken on the national forest relative to projects undertaken on adjacent forests and other adjacent land owners (e.g., other federal, state or private land owners). The evaluation would include recommendations to improve the integration of future projects on the national forest to other actions being undertaken.

Objective PLAN-2. Landscape analysis provides a basis for the cumulative analyses required of site-specific projects.

C. Standards

Standard PLAN-1. Landscape analysis (>30,000 acre area; typically defined by a watershed boundary) is completed by an interdisciplinary team prior to project development and approval. Such landscape analysis:

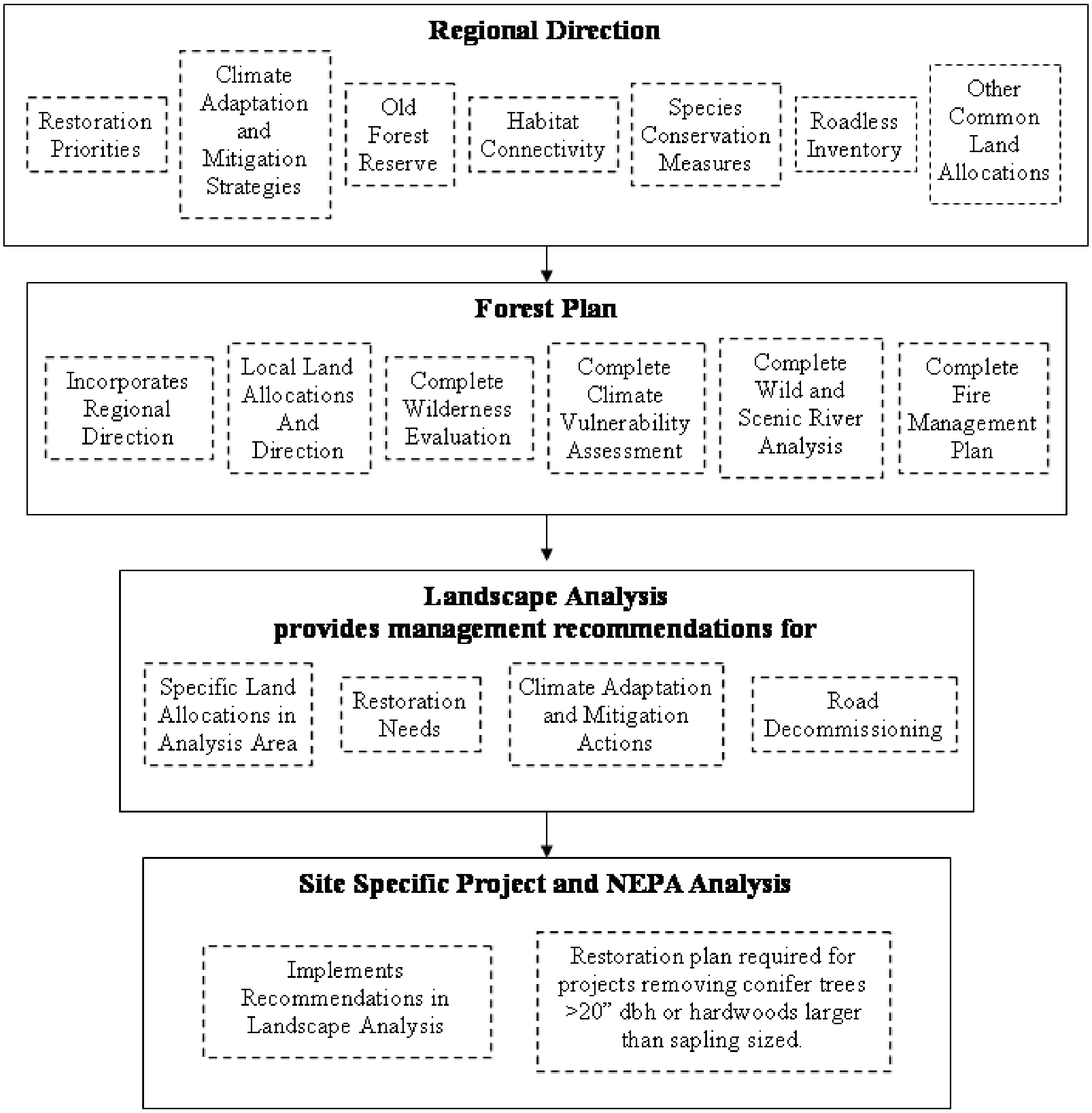
- Tiers to the information in the forest plan
- Evaluates local trends and conditions, including a consideration of other ownerships
- Evaluates pertinent science and consults with scientists as needed
- Establishes landscape specific desired conditions
- Identifies and prioritizes local restoration needs
- Identifies opportunities to address local and regionwide restoration priorities

Standard PLAN-2. Planning at the landscape and site-specific scales tiers to regional direction on a variety of issues, including but not limited to:

- Old forests and associated species
- Riparian and aquatic conservation allocations
- Roadless inventory and wilderness evaluation and recommendations
- Wild and Scenic River evaluation
- Climate adaptation strategies to address habitat connectivity and habitat integrity
- Benefits of fire as a disturbance process
- Restoration priorities
- Habitat connectivity
- Species conservation measures
- Protection of soil resources

Standard PLAN-3. Land management activities must be designed to address the restoration needs and priorities identified in the landscape analysis. (See Figure III.A-1)

Figure III.A-1. Planning Hierarchy



Standard PLAN-4. Projects proposing the removal of conifer species greater than 20 inches DBH or hardwoods larger than seedlings and saplings must include a science-based restoration plan. The restoration plan must clearly demonstrate that the proposed removals will not reduce in the short or long term habitat conditions for at risk species and will support the reintroduction of a range of disturbance processes at the space and scale reflected in the desired conditions established for the project in the landscape analysis. Projects removing conifer species with diameters less than 20 inches DBH must still meet other forest plan standards, but are not required to develop restoration plans.

Standard PLAN-5. Vegetation management projects, i.e., those projects proposing to manage vegetation to meet restoration objectives or reduce fire risk, must follow the guidelines presented in Table III.A-2 in the following section.

D. Regionwide Land Allocations

The following table proposes land allocations to be adopted throughout the Sierra Nevada region.

Additional allocations may be appropriate for an individual forest.

Table III.A-1. Land Allocations.

Land Allocation	General Description	Management Objective
Wilderness Area (WA)	Congressionally designated areas.	Defined by congressional designation.
Wild and Scenic Rivers (WSR)	Congressionally designated areas.	Defined by congressional designation.
Special areas (special interest areas (SIA), etc.)	Designated by the individual forest.	Defined by the designation.
Research Natural Areas (RNAs)	Designated by agreement among the national forest and research station.	Maintain biological diversity Provide baseline ecological information Support non-manipulative research Encourage research and university natural-history education.
Recommended Wilderness (RW)	Area that is recommended for inclusion in the NWPS by the USFS.	Preserve the wilderness character of these lands until Congress accepts or rejects the recommendations in whole or in part.
Backcountry Management Area (BMA)	An inventoried roadless area (IRA) or citizen's inventoried roadless areas (CIRA) that do not contain any national forest system roads or motorized trails.	Preserve the roadless and backcountry character of these lands. Manage them under the Roadless Area Conservation Rule with exception, prohibiting motorized over-snow vehicle use and the construction of new motorized trails.
Protected Activity Center (PACs)	Designation around known nesting sites for California spotted owl (300 acres) and great gray owl (>50 acres). Inclusion in PAC of area within 300 feet of structures is avoided.	Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy
Home Range Core Area (HRCA)	Area around California spotted owl nest site and including the PAC. Size ranges from 600 acres to 2,400 acres depending on location in the Sierra Nevada.	Provide for high quality foraging habitat near to nest stands. Manage for low risk of loss of occupancy
Post Fledgling Area (PFA)	Area (420 acres) around northern goshawk nest stand. Delineated around all birds known to be nesting.	Manage for breeding and nesting; area intended to support fledglings. Mature forest, large tree structures (live and dead), open understories. See Appendix A for additional details on desired habitat conditions.

Land Allocation	General Description	Management Objective
Forest Carnivore Den Sites	Den site buffer (700 acres for fisher; 100 acres for marten) designated around known maternal or natal dens.	Limit disturbance during denning (limited operating period). Retain habitat conditions that support denning. Limit vegetation management to reducing surface and ladder fuels to reduce fire risk until new science suggests otherwise. Restoration treatments do not remove larger white fir or incense cedar in these areas.
Old Forest and Connectivity (OFC)	Area in which old forest qualities are emphasized Area critical to the movement and flow of species associated with all habitat types across the landscape. Designed as an adaptation to climate change and other stressors.	Restore ecological process where doing so does not threaten critical values. Maintain movement opportunities across the landscape. Manage to achieve high representation (greater than 60 to 80 percent) of old forest condition.
Community Zone (CZ)	The area at risk from wildfire directly adjacent to houses or communities and generally not exceeding 0.25 miles from a community; may include access roads and other infrastructure to support community.	Create defensible and resilient conditions to protect human life and property. Reduce fuel hazards within 300 feet of structures to significantly limit wildfire effects within this zone. Reduce fuel hazards adjacent to roads providing egress from structures. Suppression would be fire management response.

Land Allocation	General Description	Management Objective
Riparian Conservation Area (RCA)	Defined by stream type and condition Ranges from 150 feet to 300 feet from the midpoint of the stream. Riparian conservation area (RCA) widths shown below may be adjusted at the project level if a landscape analysis has been completed and a site-specific assessment of the riparian conservation objectives (RCOs) demonstrates a need for different widths. Perennial Streams: 300 feet on each side of the stream, measured from the bank full edge of the stream. Seasonally Flowing Streams (includes intermittent and ephemeral streams): 150 feet on each side of the stream, measured from the bank full edge of the stream Streams in Inner Gorge: top of inner gorge (Inner gorge is defined by stream adjacent slopes greater than 70 percent gradient) Special Aquatic Features or Perennial Streams with Riparian Conditions extending more than 150 feet from edge of streambank or Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of streambank: 300 feet from edge of feature or riparian vegetation, whichever width is greater. Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs. Other hydrological or topographic depressions without a defined channel: RCA width and protection measures determined through project level analysis. Inner gorge is defined by stream adjacent slopes greater than 70 percent gradient. Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs.	Restore ecological process where doing so does not threaten critical values. Maintain, restore, enhance, and protect. Limited levels of ground and vegetation disturbance allowed. Avoid actions that retard or prevent attainment of aquatic conservation objectives.
Aquatic Diversity Emphasis (ADE)	Watershed in which protecting or maintaining aquatic diversity is the priority.	Restore ecological process where doing so does not threaten critical values. Avoid actions that retard or prevent attainment of aquatic conservation objectives. Promote low road density, generally <1.5 mi/mi^2 in the matrix, less in sensitive habitats.
Yosemite Toad (YT)	Habitat around sites with YT including wet meadows with standing water and saturated soils, streams, springs, important upland habitat, and habitat identified as “essential habitat” in the conservation assessment for the Yosemite toad.	Provide habitat conditions to support successful reproduction and persistence. Maintain hydrologic function of meadow system. Limit human uses in areas not currently in excellent condition.

Land Allocation	General Description	Management Objective
Willow Flycatcher: Occupied and Emphasis (WF)	**Occupied habitats** are meadows or riparian sites with documented willow flycatcher. **Emphasis habitat** are defined as meadows larger than 15 acres that have standing water on June 1 and a deciduous shrub component.	Provide habitat conditions to support successful reproduction and persistence. Limit human uses in areas not currently in excellent condition. Maintain hydrologic function of meadow system.
Ecological Restoration (ER)	Area outside of all other allocations.	Restore ecological process. Use planned and unplanned ignitions where safety concerns can be addressed. Area managed to achieve desired conditions established regionally and refined at the landscape level.

Table III.A-2. Vegetation management standards by land allocation.

Land Allocation	Management Standards
Spotted owl PACs	Limit treatment to prescribed burning or mechanical removal of small diameter material to reduce fire risk.
Forest Carnivore Den Sites (fisher and marten)	Limit treatment to reduce surface and ladder fuels to meet the following fuel objectives: 1) < 4-foot flame length; 2) < 20% mortality of trees >15” dbh.
Northern goshawk PFAs, great grey owl PACs, HRCA, OFC, RCA, ADE, ER	**1) Diameter limit:** 20” dbh limit with emphasis on retaining all pine (not only dominant/co-dominant) >12”. Exceptions to the above that are clearly based on ecological need for the site may include: ▪ Within conifer stands, removal of white fir or incense cedar 20-29” dbh within 30 feet of large pine (>24” dbh) with the goal of increasing light and resources available to large pine. Logged trees >20” (limbed to reduce fuel loading) should be left on site to provide down wood, if levels currently are less than ecologically desirable. ▪ Removal of white fir or incense cedar 20-29” dbh within drip line of oak hardwood with the goal of increasing light and other resources available to hardwood. ▪ Removal of conifer species around oak and other hardwoods to improve tree health; action must be balanced with need to provide for decadence and understory cover around oaks. **2) Canopy cover:** Retain at least these levels of canopy for the California Wildlife Habitat Relationship (CWHR) types: ▪ At least 60% in CWHR 5D/6 (higher levels desirable) ▪ At least 50% in CWHR 5M except where pretreatment canopy cover is less than 50%, then mechanical thinning should retain at least 40% canopy cover ▪ At least 60% canopy cover in CWHR 4D ▪ At least 40% canopy cover in CWHR 4M Vary canopy cover to avoid uniform average on each acre. Exceptions to this standard allowed are to achieve adequate reduction of ladder fuels to meet fuel objectives. **3) Retention areas:** Retain 10-25% of each treatment area unlogged or lightly modified varying by land allocation to provide for heterogeneity: ▪ 10% in Community Zones ▪ 15-25% in all other allocations

Land Allocation	Management Standards
	The goal is to create stands with vertical diversity in adjacent patches. The creation of stands that are completely cleared from the ground to the codominant and dominant canopy is to be avoided.
Yosemite Toad (YT)	Treatment limited to surface and ladder fuels when it can be demonstrated that the risk of wildfire is greater than risk of losing individuals from management activities (e.g., felling trees, skidding, equipment movement)
Community Zone (CZ)	30" DBH limit

Table III.A-3. Additional discussion of these land allocations is located in the following sections for the conservation strategy.

Land Allocation	Sections in Conservation Strategy
WA	IV. I. Protecting Roadless Areas and Recommending New Wilderness Areas
WSR	IV. J. Wild and Scenic Rivers: Evaluation and Recommendation Appendix C: Wild and Scenic Rivers: Status of Evaluations and Comprehensive River Management Plans
SIA	IV. K. Special Interest Areas and Research Natural Areas Appendix D Status of Special Interest Areas and Research Natural Areas
RNAs	IV. K. Special Interest Areas and Research Natural Areas Appendix D Status of Special Interest Areas and Research Natural Areas
BMA	IV. I. Protecting Roadless Areas and Recommending New Wilderness Areas
PACs, HRCAS, PFAs, Forest Carnivore Den Sites	IV.C. Maintain and Restore Old Forest Habitats and Associated Species Appendix A. Species Assessments and Conservation Measures
OFC	IV.C. Maintain and Restore Old Forest Habitats and Associated Species
YT, WF	IV. D. Restore and Maintain Aquatic Ecosystems Appendix A. Species Assessments and Conservation Measures
RCA, ADE	IV. D. Restore and Maintain Aquatic Ecosystems
ER	IV.A. Restoring Fire as an Ecological Process IV.B. Structural Diversity of Forests and Adjacent Habitats
CZ	IV.A. Restoring Fire as an Ecological Process

Additional information about specific land allocations is contained in the sections of the conservation strategy as noted in Table IIIA-3.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Establish a Forest Plan Revision Team to oversee the revision process on the forest and coordinate this effort with adjacent national forests and the Regional Office. Include managers and specialists in this team.
- The work plan for the Forest Plan Revision Team specifically addresses the process that will be used to ensure that the planning documents are integrated across subject or issues areas. This integration is to occur throughout the planning process and not only at the final step of plan development or adoption.

- The Forest Plan Revision Team identifies early in their work planning how scientific review and feedback will be completed during the revision process. Engagement of scientists should not be limited to those internal to the agency. Individual review of specific sections (e.g., review by an amphibian specialist of a section on Yosemite toad) and comprehensive reviews of the entire draft and final plans need to be completed and recommendations incorporated into the plan.

- The science consistency review process established by Forest Service Research is followed for the forest plan revision. Scientists internal and external to the Forest Service should be involved in these reviews and sufficient time allocated to address each issue area individually and integrated across issues in the forest plan. The planning documents and the science consistency review should clearly document how the best available science was identified and used in designing the forest plans.

- Complete a forest-wide assessment of the vulnerability of key attributes to the influences of climate change (Aplet et al. 2010). Use this assessment as a basis for identifying in the forest plan adaptation strategies to address the potential effects of changing climate and to increase the resiliency of national forest ecosystems.

Recommendations for New Regional Direction or Policy

- Create a Science Integration Team at the regional level to provide science support on region wide issues for each forest plan revision. The team should include agency and non-agency scientists, specialists, and managers.

- The Science Integration Team and other specialists should develop a regionwide trends and conditions report that identifies rangewide priorities to be addressed in each forest plan. This report needs to be completed prior to the revisions on each forest being initiated. A public review and comment process should be built into the process for creating the regionwide trends and conditions report.

- Develop a database of specialists (non-Forest Service and Forest Service) who are able to provide consultation as needed to the forest plan revision teams during the revision process. Specialists included in the database should cover the range of expertise needed to develop a forest plan, including natural resources, policy development, and social/economic.

- The region should provide direction to each forest on how to address rangewide issues and priorities in the forest plan revision. This regional direction achieves consistency in land use planning among land allocations common to all forests.

- The region should provide a rangewide approach to climate adaptation and mitigation for each national forest to incorporate into the forest plan revision. The rangewide approach developed by the region would be designed to complement climate strategies adopted by other agencies (e.g., the State of California's "California Climate Adaptation Strategy," National Park Service, US Fish and Wildlife Service).

- Establish ecologically sustainable and science-based priorities for restoration regionwide and direct national forests to work collaboratively to accomplish restoration priorities.

- Develop a regional manual and training program on conducting the required landscape analyses to ensure these are completed in a consistent and efficient manner.

- Create a Science Review Coordinator at the regional level to organize timely science consistency reviews for each forest plan revision.

- Require from each national forest written responses to the comments received in the science consistency reviews.

- Create a forum for Forest Integration Teams to come together every 2-3 years to assess forest activities and identify opportunities for integrating future work.

- Include collaboration among forests in accomplishing restoration goals as a criterion when evaluating the job performance of a Forest Supervisor.

- Provide financial incentive for national forests to collaborate with each other on restoration priorities by preferentially funding collaborative projects.

- Provide financial incentive for national forests to undertake projects that accomplish multiple priorities such as watershed health, habitat protection and restoration, and road decommissioning.

- Use the Science Integration Team to host forums on issues that affect the entire region, such as responding to climate change, conserving rangewide species and developing desired condition statements.

- Create a common archive of presentations from the science forums, research results, and references that address the management issues to be addressed throughout the region. Structure the archive so that it can be easily shared among Forest Service staff throughout the region, other agencies, and interested stakeholders.

- Create systems and opportunities for shared learning among specialists and other stakeholders involved in the forest plan revision at the regional and national forest levels. The webinars on responding to climate change that have been hosted by the USFWS (http://training.fws.gov/CSP/Resources/climate_change_webinars/safeguarding_wildlife_cc_archives.html) could serve as an example of both the technology/system to use to deliver the program and a topic area of interest. Coordinating training opportunities among state or federal agencies should be explored. (Note: This action also appears in the issue area "ensure complete scientific review of planning documents.")

- Develop tools and processes to engage the public in the planning process. The recent use of roundtables and archived presentations by the Washington Office in the development of a national rule provides an example of an approach.

- Provide training to resource staff and decision makers on the function and operation of teams, including roles and responsibilities, values, cohesion, and collaboration.

- Provide forest and district level training in designing and marking to advance heterogeneity and the retention of key ecological values in project and landscape planning. Offer this annual training to other jurisdictions, agency partners and private landowners to establish ecological restoration in an "all lands" context.

Additional Recommendations

- Identify key scientists and experts and encourage/support their involvement in the planning process.

- Identify scientists and experts in other agencies and encourage/support their involvement in the planning process.

- Maintain strong professional interactions with Pacific Southwest Research Station and encourage/support their involvement in the forest plan revision process.

- Engage the California Department of Fish and Game on actions to implement the California State Wildlife Action Plan.

- Engage the US Fish and Wildlife Service on actions to support recovery of listed species.

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ADAPTIVE MANAGEMENT AND MONITORING

ISSUE STATEMENT

Climate change is expected to significantly affect the health and vitality of forests and to create environmental conditions never before experienced by forest ecosystems, including those of the Sierra Nevada (Innes et al. 2009, Millar et al. 2007, North et al. 2009, Redmond 2006, Mastrandrea and Luers 2012, Barbour and Kueppers 2012). Incorporating climate adaptation concerns into the forest planning process proactively, before major ecosystem changes occur, will likely be less expensive and more effective than a reactive management approach in achieving forest management goals (Blate et al. 2009). Climate adaptation strategies must be incorporated at both the strategic and operational planning level in order to achieve the goal of sustainable forest management (Innes et al. 2009). Because the precise impact that climate change, in combination with other sources of ecosystem stress, will have on the Sierra Nevada is and will remain uncertain, many forest management standards or guidelines contained in the revised forest plans must be amenable to future refinement through an ongoing process that is often referred to as "adaptive management."

In theory, adaptive management involves careful monitoring of forest resources against a clear set of criteria so that unforeseen events can be identified and addressed in a timely fashion by modifying existing standards and guidelines. In practice, however, adaptive management plans designed by the Forest Service in the past have been noncommittal, unclear, unenforceable, and have not resulted in meaningful reassessment and adjustment of standards. "Agencies have often approached adaptive management in a way that prioritizes flexibility, discretion and expedited decision-making and have emphasized less the aspects of the paradigm that allow for learning or require precautious decision-making… agencies risk running afoul of the courts if they cling too strongly to agency discretion and vague adaptive management plans that are bereft of measurable standards and objectives" (Nie and Schultz 2011).

The Forest Service must incorporate into any revised Sierra forest plans an effective adaptive management strategy that assesses likely risk to key local ecosystem values from climate change in combination with other stressors; defines clear, enforceable, and timely triggers and responsive management actions for various levels of predicted impacts; monitors the real-time impact of climate change and other stressors on key Sierra species and ecosystems; and establishes enforceable benchmarks for evaluating and adjusting management (North et al. 2009, Bark et al. 2010, Nie and Schultz 2011). Species and ecosystem protections triggered under adaptive management must be reasonably specific, certain to occur, implementable, subject to deadlines or otherwise enforceable, and sufficiently protective to satisfy applicable legal standards (Nie and Schultz 2011).

In addition to management prescriptions, essential elements of an adaptive management strategy include (1) a monitoring strategy; (2) a mechanism and schedule for review of monitoring data; (3) a mechanism for public involvement in the adaptive management process; and (4) a clear set of criteria and process by which the management process itself can be evaluated and modified. Additionally, the forest plans should identify the critical research questions guiding adaptive management, recommend management actions to facilitate their experimental approach to adaptation at a landscape scale, and include a detailed plan for accomplishing the necessary research. Adaptive management strategies should be clearly articulated in each forest plan, implementable within existing and foreseeable budgetary constraints, and transparently executed with full public involvement (Nie and Schultz 2011; *see* USFS 2012).

Adaptive management in an era of anticipated rapid climate change and heightened uncertainty must be rooted in a precautionary approach to ecosystem management. Many trends and challenges over the life of a forest plan are reasonably foreseeable, even in an era of climate change and associated uncertainty. "[S]ufficient ecological knowledge and policy options currently exist for effective adaptation efforts to be implemented or improved upon today" for "the vast majority of major threatening processes to biodiversity" (Driscoll et al. 2012). "No regrets" actions that offer high ecological payoffs with minimum risk today as well as in a higher-risk climate future should figure prominently in forest management priorities (Moore et al. 2012).

The potential for ecosystem resilience in the face of both climate variability and experimental management strategies will increase by reducing current sources of ecosystem stress (e.g., habitat fragmentation, invasive species, extractive activities, grazing, land clearing, and pollution); re-establishing habitat connectivity to facilitate climate-induced species migration and dispersal; boosting depleted populations; and promoting heterogeneous, multiple-aged forest stands (Blate et al. 2009, Driscoll et al. 2012). In applying such adaptation strategies across the landscape, protected areas would be established and connected across the environmental gradients of elevation and latitude to facilitate the movement of species in response to climate change. When more active management of forests is employed to limit exposure to climate change impacts such as drought, fire, invasive species, and insects (Blate et al. 2009), additional care must be taken to minimize negative impacts to high-value habitat elements for high-risk species, e.g., decadent and intermediate-to-large trees, woody debris, and moist microclimates supporting high tree densities that are of critical importance to old forest associated species (North et al. 2009, Driscoll et al. 2012).

Adaptive management can be an integral part of dynamic landscape conservation plans geared toward preserving ecosystem function and resilience and explicitly addressing the climate adaptation needs of wildlife and biodiversity at a landscape scale (Mawdsley et al. 2009). The focus of successful management strategies will likely shift from maintaining forest structure and composition to supporting ecological process and ecosystem function (Millar et al. 2007). For example, the importance of frequent, mixed-intensity fire in shaping the Sierran mixed-conifer ecosystem suggests that adaptive management designed to manipulate the process of fire could enable our regional forests to reach dynamic equilibrium under modern changing climate conditions, increase forest heterogeneity, and bolster resilience to climate change.

Forest plans and associated environmental impact statements should be guided by a vulnerability assessment that "employs the best available science to characterize vulnerability, uses state-of-the-art modeling to assess likely exposure to climate change and its effects, and documents sources of uncertainty" (Aplet et al. 2010). Vulnerability assessments are fundamental to the forest planning process in the face of climate change. They are used to examine forest resources and determine which elements are sensitive and which have the ability to adapt, while also identifying the likely consequences to those resources of anticipated climate change (Aplet et al. 2010; *see, e.g.,* Santos et al. 2012). Vulnerability assessments can and should assess other stressors that will likely interact synergistically with climate change and amplify its impacts, such as habitat change, pollution, and increasing resource demands (Santos et al. 2012, Hansen and Hoffman 2011, Driscoll et al. 2012). Adaptive management informed by vulnerability assessments would prioritize actions designed to reduce vulnerability of key local resource values through such strategies as reduction of anthropogenic stressors, establishment of reserves, regulation of recreational use, and habitat restoration (Aplet et al. 2010).

While the impacts of climate change may or may not manifest themselves over the life of the forest plan revision, the goal of an adaptation-based adaptive management strategy is to test and refine responsible management strategies in light of evolving science, anticipated future climate conditions, and monitoring results in order to better inform future management efforts, guide ecosystem response to climate change as it unfolds, and effectively manage risk to our forest resources. Whenever there is a likely link between experimental manipulation and outcomes, adaptive management that incorporates experiments into modeling is possible. Experimental actions under adaptive management "should be designed to do no harm, be flexible (maintaining the ability to reverse mistakes), and address the areas of greatest need, effectively minimizing negative climate impacts on biodiversity and natural resources" (Moore et al. 2012). Conservative pilot projects should precede large-scale deployment of any action with uncertain and potentially negative consequences to species or ecosystems (Id.).

In situations where high uncertainty is coupled with low controllability of outcomes (when system manipulations are difficult or impossible), the strategy of scenario planning can be particularly helpful (Peterson et al. 2003, Aplet et al. 2010, Welling 2008, Moore et al. 2012). "The central idea of scenario planning is to consider a variety of possible futures that include many of the important uncertainties in the system rather than to focus on the accurate prediction of a single outcome" (Peterson et al. 2003). Scenario planning can help create a set of resource management steps for national forests that are robust to multiple climate futures (Moore et al. 2012). In the forest planning context, it could involve developing strategic responses to high, medium, and low climate disturbance scenarios for a suite of locally important measurable resource values (e.g., ecosystem diversity or water quality and fish habitat), which can be examined under NEPA in the planning process. Though the forest plan must include a streamlined review and public comment provision for such decision points, this type of scenario-based planning has the benefit of enabling managers to change course rapidly once the plan has been adopted, as several different options will already have undergone the NEPA process and can therefore be readily used (Nie and Schultz 2011). This approach can also save some later analysis costs (*see* Bark et al. 2010).

To better inform adaptive management and scenario-based planning, and to make clear when new scenarios or new management strategies are needed, forest plans must include comprehensive monitoring systems to better understand the changing forest system over time, including critically important species-level monitoring. "[W]ithout monitoring, there can be no improved understanding of conditions or responses to management actions, and therefore, no informed adjustment of on-the-ground practices" (Nie and Schultz 2011). Robust monitoring of ecosystems and forest management responses provides both a basis for vulnerability and risk assessments and a means of evaluating the effectiveness of strategies to reduce stressors and adapt to changing conditions (Blate et al. 2009, Innes et al. 2009). Ecologists should be involved in the design and integration of robust monitoring programs that include a formal system for regularly evaluating monitoring and research data, and triggers should be clearly defined for management adjustments and forest plan amendments based on changes detected through monitoring (Driscoll et al. 2012). Existing monitoring systems should be assessed, strengthened, and better coordinated in light of anticipated increased demands for effective collection, analysis, and interpretation of environmental information (Mawdsley et al. 2009; *see also* USFS 2010). Both stand- and forest-level monitoring are necessary for adaptive management to be truly effective (Innes et al 2009), and broader-scale monitoring is another foundational requirement for adaptive management under the 2012 National Forest Management Rule. 36 C.F.R. § 219.12(b). Formal evaluations of ongoing monitoring results, ideally involving independent scientists as well as Forest Service staff, are required every two years under the 2012 National

Forest Management Act rule. 36 C.F.R § 219.12(d).

Support for adequate monitoring is the fundamental anchor fostering science-based, well-informed adaptive management. Absent adequate funding for monitoring, adaptive decision-making will suffer from high levels of uncertainty and a loss of public trust. Given the high stakes associated with rapid environmental change, the Forest Service must shift priorities to include significant funding for robust, multi-scale monitoring as a key component of future forest plans in the Sierra Nevada. If resources are not available for effective and ongoing monitoring, the Department of Interior guidelines recommend that adaptive management not be employed (Williams et al. 2009). "Simply put, adaptive management is not possible without effective monitoring" (Id. at 12).

As mentioned above, incorporating climate adaptation concerns into the forest planning process proactively, before major ecosystem changes occur, will likely be less expensive and more effective than a reactive management approach in achieving forest management goals. Given the uncertainties associated with climate change and the high level of risk posed to Sierra Nevada forest resources, adaptive management and scenario-based planning are some of the best tools currently available to forest planners and should be responsibly incorporated into forthcoming forest plan revisions.

Policy Actions Needed

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the administrative setting and may not reflect the current conditions.*

Desired Condition AM-1. Social and administrative infrastructure is in place to support the flexible management necessary to respond to changing climate and other shifting ecological pressures.

Desired Condition AM-2. Thresholds that trigger changed management are established and detailed management alternatives are developed for various predicted climate and ecosystem response trajectories.

Desired Condition AM-3. The adaptive management cycle is transparently implemented and accessible to the public.

Desired Condition AM-4. Regular reports on monitoring and responsive management proposals are made available to stakeholders by dates certain.

Desired Condition AM-5. A structure for collaboration is established that defines how public involvement will be facilitated, how information will be shared, and how conflicts will be resolved.

Desired Condition AM-6. Risk and uncertainty are clearly articulated and addressed, with vulnerability assessment informing the management decision process.

B. Objectives

Objective AM-1. Implement an adaptive management program (AMP), involving both scientists and managers, that incorporates the following steps:

1. Evaluate the potential set of climate and ecosystem conditions over the lifetime of the new plans and the likely range of management responses.

2. Gather and synthesize existing knowledge to develop working model(s) about how the ecosystem works in order to make first approximation predictions of future conditions and management outcomes. Clearly identify what is known (certain) versus unknown (uncertain) with respect to future conditions and management outcomes.

3. Assess risk, exposure, uncertainty, and vulnerability associated with key local resource values.

4. Determine current management goals based on these comprehensive risk and vulnerability assessments.

5. Identify the resources, skills, and infrastructure needed to implement monitoring and adaptive management.

6. Identify thresholds or benchmarks that will be used to trigger a review of management.

7. Design and implement management in accordance with principles of experimentation.

8. Monitor, evaluate, and disclose the results of the management action by dates certain and at least every two years (36 CFR § 219.12 (d)).

9. Incorporate what is learned into the conceptual model of how the ecosystem works, basing future management on improved understanding of ecological processes.

10. Collaboratively and transparently adjust management as indicated by results

Objective AM-2. Integrate results from the forest-specific AMP with the regional AMP framework, as appropriate.

Objective AM-3. Define and support a collaborative stakeholder process for sharing and vetting monitoring information with the public in a open, transparent and consistent manner.

C. Standards

Standard AM-1. The ongoing implementation of the all aspects of the AMP is a prerequisite to project approval and implementation. For example, if meadow condition assessment and evaluation has not been completed, activities that have the potential to impact meadow systems may not be permitted or approved until the annual monitoring and evaluation have been completed.

Standard AM-2. The AMP is both internally and independently reviewed at five year intervals (at a minimum) to evaluate its effectiveness in meeting the goals and objectives in the forest plan.

Standard AM-3. Where uncertainty and potential risk associated with management actions are high, the precautionary principle must guide adaptive management. Activities are assessed for risks associated with a full range of actions and management options. More aggressive action should be limited to ecosystems that are most degraded.

Standard AM-4. All projects will be consistent with the forest plan standards, which should include the global standards for the following issue areas which are described in detail in Section IV for this conservation strategy, in addition to any forest-specific standards designed to protect locally important resource values.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Ensure that there are adequate resources, including funding and staff with the appropriate qualifications, to effectively monitor forest conditions and resource values and implement responsive, transparent adaptive management.

- Establish completion of monitoring goals and disclosure of results as prerequisite to approval of actions proposed as part of an adaptive management strategy.

Recommendations for New Regional Direction or Policy

- Focus the allocation of funds from the Regional level to the National Forest level to actions that are justified by monitoring results and that have been demonstrated to be consistent with the regional standards defined above.

- Use the adaptive management and monitoring strategy developed at the national forest level to determine the allocation of funds from the Region to each national forest. Allocate funds first to those monitoring and adaptive management efforts addressing information gaps that have implications for regional management beyond the specific national forest and which present low risk to key resource values.

- Design an adaptive management and monitoring framework for rangewide issues that integrates actions undertaken and information gathered at the forest level with forests throughout the region.

- Provide scientific oversight and support for the adaptive management program.

- Ensure that an ongoing technical and scientific capacity will be available to the policy and management bodies to evaluate, review, and assist in design of adaptive management strategies where appropriate.

- Use a collaborative process among managers, technical staff and stakeholders to design an integrated Adaptive Management Program (AMP) for the region and each national forest. Experiences gained during the Practices from the Sierra Adaptive Management Project should help inform this process, e.g., http://snamp.cnr.berkeley.edu/documents/465/.

Additional Recommendations

- Promote the involvement of staff and decision makers from California Department of Fish and Game, US Fish and Wildlife Service, California Regional Water Quality and other relevant resource agencies in the development and implementation of the AMP.

- Promote the involvement of local and statewide conservation groups in the development and implementation of the AMP.

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Restoring Fire As An Ecological Process

Issue Statement

Fire is a natural ecological process in the Sierra Nevada, equal in ecological significance to floods, volcanic eruptions, hurricanes, and other natural disturbances (Lindenmayer and Noss 2006). The Sierra Nevada experiences a mixture of fire severities ranging from low to patches of high severity in the mixed conifer region (McKelvey and Busse 1996, Collins et al. 2007) to largely high fire severity in chaparral-dominated ecosystems (Sugihara et al. 2006). The variety in burn severity across the landscape provides important ecological benefits to the forest including: preparing the seedbed for germination, cycling nutrients and replenishing minerals, modifying conditions promoting wildlife habitat and forage, creating structural heterogeneity, minimizing disease and pathogens, and reducing or increasing fire hazard (Kilgore 1973).

Fire in the Sierra has shaped forest structure and composition for centuries (Skinner and Stephens 2004, Sugihara et al. 2006). It is a natural and essential disturbance process in maintaining long-term ecological function of the flora and fauna, soil nutrient recycling, structural diversity, and composition throughout the Sierra Nevada. Human activities such as logging, livestock grazing, fire suppression (Hutto 2005, Stephens et al. 2009), increased development (Sierra Nevada Alliance 2007), and stricter air quality regulations (California Air Resources Board, CCR Title 17) have altered the natural fire regimes in the Sierra forests creating an overabundance of live and dead fuels. As a result, the Sierran ecosystems are at greater risk from the effects of uncharacteristic fires[1] in areas that would have historically burned more frequently and at lower intensities. Estimates of the area burned prior to the 1800s in California range from 4.5 to 12 percent each year (Stephens et al. 2007). In contrast, about 0.2 percent on average was affected by managed fire each year in the Sierra Nevada during the period 2001 to May 2009 (Silvas-Bellanca 2011). Continuing to exclude fire from the Sierra Nevada poses a great threat to the health and resiliency of each ecosystem.

Today's forests are often not in a condition that can be safely burned. In some cases, the dense accumulation of small trees and other ladder fuels needs to be reduced through mechanical treatments prior to the application of fire. However, it is important to note that mechanized treatments alone generally do not reduce the level of surface fuels (Graham et al. 2004) and cannot replace fire and its ecological role on forested landscapes. Studies have found fire to be highly effective in treating surface and ladder fuels, whereas mechanical treatments alone are considerably less effective (Stephens and Moghaddas 2005). While such treatments are designed to reduce extreme fire effects, they can be ineffective under severe weather conditions because high surface fuel loads remain on site following treatment (Safford 2008). Mechanized treatments need to be carefully designed to meet conservation and restoration objectives in the short and long term (North et al. 2009). Limiting disturbance in sensitive areas, retaining important forest structure and creating structural heterogeneity are all important concepts to address when designing mechanical fuel treatments.

The forest plan revision process is the opportunity to address directly the strategic use of fire on the landscape, and suppression to manage for multiple benefits of natural resources and human communities. Promoting the strategic use of fire will allow low, moderate, and high severity fire effects in the Sierra Nevada creating a more natural, healthy, and resilient landscape. In the coming years, it will be critical to enhance the ecological role of fire on a larger scale than the current management program.

[1]Uncharacteristic fire – an increase in wildfire size and severity compared to that which occurred within the historic range of variability. The historic range of variability is a condition that will inform managers, but may not be the desired outcome.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition F-1. Planned and unplanned ignitions are managed to promote fire as an ecological process to increases the resiliency and a range of diverse habitat.

Desired Condition F-2. Planned and unplanned ignitions produce a range of beneficial effects within the natural range of variation for each fire-adapted landscape.

Desired Condition F-3. Post-fire environments provide a range of beneficial effects that include all stages of forest development.

Desired Condition F-4. Human structures and areas close to human communities are resilient to catastrophic loss.

Desired Condition F-5. Interagency and inter-governmental planning occurs across boundaries to promote fire as an ecological process on a landscape level.

B. Objectives

Objective F-1. By Year 10 of the forest plan, treat annually 1.5% of the total national forest land base with planned and/or unplanned ignitions.

Objective F-2. Manage planned and unplanned fires to maximize ecological benefits to the affected landscape. Manage all wildland fires using strategies and tactics commensurate with protection of human health, safety, and natural and cultural resource values. Utilizing existing interagency wildland fire planning procedures, analyze risks and complexities for all ignitions in order to determine which can be successfully managed for ecological benefit while responding to human safety, versus those that should be suppressed (e.g., Sequoia and Kings Canyon Fire and Fuels Management Plan (NPS 2005).

Objective F-3. Fire behavior in the Community Zone[2] (CZ), along major transportation routes, and close to other key infrastructure is limited to surface fire with a low potential for crown fire.

Objective F-4. The biological legacies and heterogeneity associated with a variety of fire effects occur in post-fire environments at levels that reflect desired conditions and the natural range of variability.

Objective F-5. All land allocations in the forest plan specifically address how planned and unplanned ignitions will be used to increase forest resilience and provide ecological benefits for multiple habitat types.

Objective F-6. Fire plans promote the use of planned and unplanned ignitions and should be completed for each national forest by Year 5 of the forest plan.

Objective F-7. Plan and implement appropriate treatments to reduce the threat to values from uncharacteristic fire and to restore or maintain ecological values.

C. Standards

Standard F-1. All projects proposed in fire-adapted plant communities must tier to existing fire plans and include an unplanned ignition management plan for land allocations that are outside the Community Zone.

Standard F-2. Project planning documents address the following:

- Fire risk and hazard assessment,

[2] Community Zone: The area at risk from wildfire directly adjacent to houses or communities and generally not exceeding 0.25 miles from a community.

- Identification of sensitive areas and protective actions to implement during fire suppression actions,
- Identification of sensitive smoke areas, and mitigations for smoke,
- Identification of operationally logical and ecologically appropriate planned fires' perimeters during NEPA analysis to allow fire operations the most flexibility to accomplish acres; planned fire acres should not be bound to harvest boundaries within projects,
- Desired condition statements that identify the acceptable range of fire effects and post-fire conditions and affirmatively identify the desired low, moderate, and high severity fire effects and their ecological benefits,
- Identification of conditions that would necessitate post-fire treatment actions,
- Beneficial accomplishments of fire that can be measured by quantitative objectives.

Standard F-3. Project proposals modifying vegetation to increase fire resiliency must identify the post-treatment management requirements to maintain fire resiliency over time.

Standard F-4. Fire suppression efforts avoid damaging the natural resources at risk. Placement of fire lines, the use of back-fire techniques, and other ground disturbing techniques shall be informed by critical resource maps and with input from zone ecologists and deployed in a manner that poses the least impact to existing resources while still meeting the need to achieve fire suppression.

Standard F-5. Each Ranger Unit will have completed fire plans and annual burn plans ready for burning windows and with maps that include:

- Identification of areas where managed fire is highly possible if opportunities were to arrive.
- Higher elevation areas without structures or high levels of public use.
- Cultural resource areas needing protection.
- Key plant communities in need of burning.
- Sensitive species nesting or denning periods.
- Areas of recent past fires which act as control areas on rate of spread.
- A minimum of 3,000-5,000 acres per year with environmental analysis (NEPA) to support prescribed fire.

D. Regionwide Land Allocations

Table IV.A-1. Land allocations related to fire and fire management concerns.

Land Allocation	**Definition**	**Management Objective**
Community Zone (CZ)	The area at risk from wildfire directly adjacent to houses or communities and generally not exceeding 0.25 miles from a community; may include access roads and other infrastructure to support community.	Create defensible and resilient conditions to protect human life and property. Reduce fuel hazards within 300 feet of structures to significantly limit wildfire effects within this zone. Reduce fuel hazards adjacent to roads providing egress from structures. Suppression would be fire management response
All other land allocations	See Section III.A. for other land allocations	See Section III.A. for other land allocations

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Ensure that there is an adequate staffing level with the appropriate qualifications to implement increased levels of managed fire during the fall and spring.

- Increased staffing from November to May to provide adequate staffing for fuels reduction activities such as prescribed burning, pile burning, limbing and thinning of trees <6" in late fall or winter at the proper pace and scale.

- Agency administrators will train, qualify, and certify available personnel for local fire needs, and interagency fire management priorities (WFEC 2009).

- Develop for the public a consistent message with uniform language about the role and ecological importance of fire to increase the understanding of the associated risks and benefits.

- Each National Forest shall commit fire staff to key community fire planning efforts in each county adjacent to the national forest to support "Firewise" community fire planning and projects in the community zone.

Recommendations for New Regional Direction or Policy

- Focus a large percentage of allocated funds from the Regional level to the National Forest level to treatments that will increase resilience and forest health while enhancing wildlife habitat with the use of managed fire. Projects should be prioritized based on meeting these objectives stated above since they are interrelated.

- Use the analysis completed to determine the allocation of funds from the Region to each national forest. Allocate funds to treat areas of the highest priority first (near communities and wildland urban interface areas).

- Fire management policy and Forest Service leadership supports biodiversity and ecosystem function through the use of prescribed burning and natural fire (Odion et al. 2009).

- Fire Management Plans and Land/Resource Management Plans establish flexibility, which will allow managers to more easily designate fires, regardless of ignition source, as an ecologically and appropriate use of fire for resource benefit.

- Apply the definitions of "managed fire" and "uncharacteristic fire" presented in this conservation strategy to fire planning and management in Region 5.

- Promote interagency and inter-governmental planning (WFEC 2009).

- Encourage landscape scale planning across jurisdictional boundaries (WFEC 2009).

- Using adaptive management, conduct internal reviews of the fire management programs to determine the following: consistency of policy implementation, effectiveness of interagency coordination, and progress towards ecosystem resiliency.

- During this forest plan revision cycle forests should use the recommendations in Hood (2010) to protect rare large tree structures that have missed several fire cycles.

Additional Recommendations

- Develop a pilot project with agencies and stakeholders to implement a managed burn on a landscape scale (>10,000 acres) that closely mimics fire behavior and fire return intervals associated with different slope positions, aspect, and slope steepness, and create diversity among species (Sherlock 2007, North et al. 2009).

- Establish a Prescribed Fire Council for the southern Sierra Nevada region that is modeled after the Northern California Prescribed Fire Council (http://www.norcalrxfirecouncil.org/) as a mechanism to promote the use of fire as an active management tool and to create a shared learning environment for agencies, practitioners and other stakeholders.

- Evaluate the barriers to implementing prescribed or managed fire by national forest and create strategies to overcome those barriers.

- Compare smoke production for recent years, including extreme years, with estimates of smoke produced from managed fire over the same or more area. Use this information to evaluate opportunities to use managed fire to reduce the burden of smoke.

- Design and implement an active public awareness program that highlights the role of fire in the forest ecosystem and the importance of treating the excessive accumulation of fuels. Focus the educational program on local residents of the wildland urban interface, nearby communities, and those likely to be affected by drifting smoke.

- Promote the land allocations for community zone allowing for planned and unplanned ignitions to be used with more flexibility.

- Using adaptive management, conduct interagency reviews of the fire management programs to determine the following: consistency of policy implementation, effectiveness of interagency coordination, and progress towards ecosystem resiliency.

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STRUCTURAL DIVERSITY OF FORESTS AND ADJACENT HABITATS

ISSUE STATEMENT

Habitat complexity has long been associated with greater species diversity and abundance (Urban and Smith 1989, Halaj et al. 2000, Burnett et al. 2007). Habitat structure influences the quality of microclimate, food abundance, and cover. It is an important consideration in how Sierra Nevada shrublands and forests are managed.

Diversity of vegetative structure is created under an active fire regime, with insect and pathogen (mistletoe, fungi, root rot) activity (Spies et al. 2006), as well as fluctuations in climate, soil conditions, and position in the landscape (North et al. 2009). Natural disturbances such as fire, insects and disease also act to reduce stand density and create forest openings that support early-seral stage vegetation as well as the animals that depend on it (see Table 1). Climate change may increase the intensity of some of these disturbances; however, resilience to climate change is best arrived at by allowing fire to regulate structure and succession (Hurteau and North 2010).

Early successional forested ecosystems provide high species diversity and unique food webs and species assemblages (Swanson et al. 2010). For example, almost a quarter of breeding birds in the Sierra Nevada nest in shrub habitat (USDA Forest Service 2007). Migratory mule deer herds also depend on early-seral landscapes dominated by shrubs and herbaceous plants to survive winter and spring. Sierran ecosystems have also evolved with and depend on natural disturbances to create habitat in dead and dying trees. The pallid bat, Vaux's swift, fisher and black bear rely on various-sized cavities in large snags and logs. The black-backed woodpecker is a fire specialist largely restricted to burned areas. Unfortunately, 120 years of fire suppression in the Sierra Nevada has produced a homogenized forest structure (Beaty and Taylor 2008), eliminated large snags, and has significantly reduced chaparral (Nagel and Taylor 2005. USDA Forest Service 2007). To reverse this trend, disturbance regimes should be managed to operate within the natural range of variability to support structural and biological diversity.

Structural diversity of vegetation is achieved by varying patch size and distribution at several spatial scales. At the small scale (¼ acre to tens of acres), desired heterogeneity is expressed in clumped, unevenly aged, and irregularly distributed vegetation. At the landscape scale, heterogeneity is expressed in a patchwork or mosaic of vegetation structure, age, and type (Spies et al. 2006). Forests and shrublands in dry landscapes such as the Sierra Nevada are species rich and should contain a variety of species which may include conifers, hardwoods, shrubs and herbaceous plants. The restoration of forest structure should begin by quantifying the range of natural variability for vegetation under natural disturbance regimes (Youngblood et al. 2006). In general, more mesic forests contain multilayered canopies with shade-tolerant, fire sensitive species, high stem density, and a mixture of pine and fir species (Spies et al. 2006). Fire severity was historically greater in mesic sites, although less frequent, creating contrasting conditions of young, uniform stands and older, structurally diverse ones (Id.). A complex, fire-adapted forest structure generally consists of 1) large diameter trees, preferably pine where appropriate for site conditions; 2) a spatially complex pattern of stand structural units (e.g., large tree groves and open areas of dense regeneration); 3) coarse wood habitats (snags and logs); 4) well-developed understory communities of herbs and shrubs; and 5) moderate tree stocking levels (Johnson et al. 2007). Timber marking guidelines should avoid even tree spacing and should carefully protect microhabitat types such as irregularities in tree structure, a variety of hardwoods, cold pool pockets and other elements, as these features are unnaturally lacking in the Sierra Nevada (North et al. 2009).

Traditional American, production-based forestry aims to create tree diameter distributions that allocate most of the growing space in a stand to the smallest trees, known as the reverse J-curve diameter distribution (O'Hara and Gersonde 2004). Thinning from below moves beyond production forestry to address ladder fuel concerns while retaining larger trees in a stand. Thinning from below is now widely practiced on public land in the Sierra Nevada, and often leaves trees spaced evenly from each other, regardless of their aspect or position on the slope. North et al. (2007) found this practice still favors the reverse-J model and does not recreate old forest conditions prevalent before logging. Historic forest conditions contained "clumps" of large trees that grow close to one another, providing important dense canopy habitat (Taylor 2004, North et al. 2007). The next step for public lands forestry is to enhance and restore important habitat structure and function by increasing heterogeneity in the retained stand structure and protect older stands and old forest ecosystems to restore what has been lost as a result of unsustainable human demand.

Simplification of Forest Structure

Intensive forestry practices such as clear-cutting and post-disturbance logging simplify forest structure and composition causing reduced ecological resilience, reduced genetic variability, and impaired function (Centers for Water and Wildland Resources 1996, DellaSala et al. 1996, Patel-Weynand 2002, Mackie et al. 2008). Forest simplification and fire suppression together contribute to greatly increased probabilities of large, uncharacteristic fires and increased frequency and severity of widespread mortality from epizootics such as bark beetles and fungal pathogens (Centers for Water and Wildland Resources 1996, DellaSala et al. 1996). Pathogens such as the introduced white pine blister rust and *Anosus* root fungus are also spread by logging. Further, soil compaction from logging and development activities can alter the pattern of natural succession. When coupled with climate change, fire suppression, and other types of habitat loss, intensive forestry practices may contribute to local extirpations of taxa associated with both early successional and old growth forests (e.g., Loft and Smith 1999; Loreau et al. 2001; Loarie et al. 2008; Mackie et al. 2008; Thompson et al. 2009; Swanson et al. 2010).

Post-fire or "salvage" logging is a long practiced yet scientifically unsupported method of forest management. Often cited as a necessary management tool for aiding in forest restoration following a wildfire, salvage logging can and often does accomplish the opposite result by increasing the fire hazard, degrading water quality, and impairing the habitat and ecological function of the forest (Beschta et al. 2004, Karr et al. 2004, Donato et al. 2006, Noss et al. 2006, Shatford et al. 2007, Thompson et al. 2007, Lindenmayer et al. 2008). Tree plantations installed post-fire create a uniform forest structure that contributes to increased fire hazards throughout the Sierra Nevada, and their presence throughout the forest makes a return to the natural fire return interval difficult (Sapsis and Brandow 1997, Franklin and Agee 2003, Franklin 2004, Stephens and Moghaddas 2005a). Natural tree regeneration can be abundant after fire, and post-fire logging may actually reduce regeneration by as much as 71 percent (Shatford et al. 2007).

In 2005, a Government Accountability Office (GAO) report commissioned by Congress confirmed that the Forest Service in Regions 5 and 6 (California and Oregon) failed to move beyond outdated management standards for reforestation (Government Accounting Office 2005). According to one regional official, the Forest Service's history of timber production permeates current thinking, and many procedures do not reflect the current management emphasis on ecosystem health. The GAO reported that regional culture emphasized planting – the most expensive approach – to reforestation projects.

Wildlife species depend on habitat conditions created by high severity fire and that result in abundant standing dead trees. Meeting desired habitat conditions for some species often requires substantial areas to be protected from post-fire logging (Hutto 1995; Noss et al. 2006). Where post-fire logging is conducted, all larger diameter dead trees and logs should be retained. Snag density targets of 80-120 snags/acre may address the needs of wildlife in burned forests (Hutto 2006). Coarse woody debris should be managed to mirror levels characteristic of the natural disturbance regime. There is rarely either an ecological or economic necessity to replant, and natural regeneration after fire is preferable from an ecological standpoint (Franklin and Agee 2003, GAO 2005, Lindenmayer et al. 2008). Burned areas should be managed as opportunities to benefit biological diversity, especially snag dependent and shrub-dependent species, over a long timeframe measured in decades.

Post-fire, herbicides are used by the Forest Service on shrubs and herbaceous plants. Herbicides are also used in fuel breaks to kill unwanted vegetation. Using chemicals instead of fire to reduce fuels is highly undesirable from an ecological standpoint. This practice simplifies habitat structure, removes harmless endemic plants and important food and shelter for wildlife. The Forest Service has reforested burned areas using entirely non-chemical means[1]. This practice is effective and should be the standard approach.

Livestock grazing is another threat to the Sierra Nevada's early-seral habitats. The impacts of grazing on riparian and aquatic habitats are addressed in a separate section of this conservation strategy; however, where livestock grazing is excessive, forage can become scarce, causing livestock to consume shrubs, hardwoods, and riparian vegetation (Bunn et al. 2007). Management direction for livestock needs to address the protection of important habitats and resource staff need to be adequately trained and funded to conduct the necessary monitoring and enforcement.

Biomass removal, shredding or mastication practices can remove large amounts of understory trees and shrubs. These practices should be used carefully to retain patches of natural regeneration and structural diversity as discussed above. Managed fire that achieves a varied pattern of fire intensity is a preferred tool to reduce unnatural understory density and maintain a heterogeneous spatial pattern. Mechanical treatment of ladder fuels may be desirable in areas that have not had fire in a long time; however, managers should still ensure that variable patches of understory vegetation are left prior to reintroducing fire. These areas can be chosen from landscape features such as forest openings, rocks, riparian areas, clumps of trees, etc.

Future impacts of climate change on vegetation in the Sierra Nevada will vary. Snowpack is projected to decrease by over 40 percent in fall and nearly 70 percent in winter, reducing winter snowmelt by 54 percent compared to the late 1900s (Morelli 2009). A recent review shows that while the Douglas fir/white fir/Sierran mixed conifer and mixed chaparral/montane hardwood types have increased since 1930, blue oak, ponderosa pine, Jeffrey pine, and eastside pine have decreased significantly (Id). The impact of climate change on forests is complex and difficult to predict. While climate change may increase tree growth rates in U.S. as a result of increasing temperatures and lengthening growing seasons, this effect may be moderated by drought conditions (McMahon et al. 2010). Post-fire management must be informed by current vegetation trends and predictions rather than managing to historic conditions in a changing climate. In some scenarios, allowing shrubs and oaks to recover naturally after fire is not only ecologically desirable, but possibly the most viable option in mid-elevation areas where climate and vegetation models indicate pines may be replaced by hardwoods.

There is uncertainty surrounding the effectiveness of current silviculture treatments in providing or protecting structural diversity (USDA Forest Service 2001, Volume 4, p. E-48), yet it is critical

[1] Source: USDA Region 5 Forest Service Pesticide Use Reports (1999–2007). On file in Pacific Southwest Region Headquarters, Vallejo, CA.

now to take steps to reverse the simplification of habitat. The forest planning process is a strategic place to frame the restoration goals for the landscape and strengthen scientifically informed goals of vegetation management using fire as a primary tool.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition DIV-1. Stands of vegetation are variable at multiple scales (not homogeneous) as a result of variation in the flora, climate, topography, and disturbance (Spies et al. 2006).

Desired Condition DIV-2. Forest stands contain adequate pine and hardwood regeneration as well as shade-tolerant tree species.

Desired Condition DIV-3. Small openings in the forest are dispersed among stands of large mature trees and vegetation with herbaceous and shrub species that are within the potential natural vegetation of the site.

Desired Condition DIV-4. Insects, disease, and tree mortality positively influence stand dynamics by creating structural complexity with pockets of mortality that allow vegetation to regenerate and provide large dead trees to enrich soils, waterways and wildlife habitat. Mortality occurs according to a range of natural variability in each forest type (Spies et al. 2006, Michel and Winter 2009) and at multiple scales (e.g., 2-5 acres, stand level and watershed or larger).

Desired Condition DIV-5. Variation in vegetation composition, aspect and slope contribute to disturbance that ranges from mild to severe (Spies et al. 2006).

Desired Condition DIV-6. Managed fire occurs across the landscape at a pace, intensity, and scale appropriate to site conditions (Fontaine et al. 2009; Scholl and Taylor 2010; Swanson et al. 2010), and functions as an ecological process that increases the resiliency and health of fire-adapted landscapes.

Desired Condition DIV-7. Areas affected by wildfire support all seral stages of vegetation including native shrub, hardwood, and herbaceous plants that would be found on the site under a natural disturbance regime. Periods of early-seral hardwood and shrub dominance following fire extend in time to reflect the pace of vegetation growth and development (Fontaine et al. 2009).

Desired Condition DIV-8. Post-fire environments provide a range of beneficial effects in fire-adapted landscapes, such as repeated burns to reduce fuels, and promotion of biodiversity and ecosystem function (Fontaine et al. 2009, Scholl and Taylor 2010, Swanson et al. 2010).

B. Objectives

Objective DIV-1. Landscape analysis identifies the locations and characteristics of the existing structural complexity, biodiversity, habitat connectivity, and natural disturbance processes to promote climate resilience and biological legacies such as old trees and snags, and identifies protection measures for these values to be incorporated into site-specific projects.

Objective DIV-2. Manage for shrubs by establishing and maintaining:

- Uneven-aged conifer stands with structural diversity including multiple canopy layers and openings that support shrub and herbaceous understory (Burnett et al. 2008);
- The long term viability of shrub habitats (Burnett et al. 2008; North personal communication 2008);
- Areas that are or have the potential to regenerate mixed species shrubfields (e.g.

whitethorn, manzanita, chinquapin, gooseberry, etc.). Mixed species shrub habitats have higher diversity and abundance of shrub nesting bird species than monotypic stands (e.g. manzanita fields) (Burnett et al. 2008);
- Prescribed fire treatments in decadent shrubfields where growth and live vegetative cover are now reduced. Manage these areas for regeneration of a newly invigorated shrub community (Burnett et al. 2008);
- Dense clumps of riparian deciduous shrubs and trees interspersed with tall lush herbaceous vegetation (Burnett et al. 2008).

Objective DIV-3. Manage for hardwoods, including alder and aspen, by establishing and maintaining:
- A diversity of structural and seral conditions in landscapes in proportions that are ecologically sustainable at the watershed scale;
- Sufficient regeneration and recruitment of young hardwood trees over time to replace mortality of older trees;
- Sufficient quality and quantity of hardwood ecosystems to provide important habitat elements for wildlife and native plant species.

Objective DIV-4. Human caused and naturally ignited fires are managed to maximize ecological benefits.

Objective DIV-5. Prioritize fuel treatments in areas that historically supported more frequent fire and contain dry mixed-conifer forests with high existing levels of understory fuels.

Objective DIV-6. All land allocations in the forest plan specifically address how managed fire will be used to increase resilience and provide ecological benefits.

Objective DIV-7. Reduce forest degradation (e.g., air pollution, fragmentation, uncharacteristic fire, disease, unnecessary driving and equipment hauling, and invasive species) to minimize forest management's contribution to carbon emissions.

Objective DIV-8. Eradication or containment plans have been created for 75 percent of the area known to be affected by noxious weeds.

Objective DIV-9. Projects and decisions shall utilize the best scientific information on ecological restoration and ecological conditions, including North et al. (2009) and North (2012).

C. Standards

Standard DIV-1. Projects are designed to maintain, enhance, and not degrade structural diversity (e.g., stem density, canopy cover, snag and downed log density, hardwoods, etc.) as defined by the desired conditions in the forest plan and are guided by the desired conditions established during landscape analysis.

Standard DIV-2. Use thinning primarily to develop or protect vertical and horizontal forest structure to make forests more resistant to uncharacteristically severe fire (Youngblood et al. 2005). Where crown density needs to be reduced to restore forest structure, retain large live and dead trees, increase height to live crown, reduce fine surface fuels, retain large woody debris, and increase understory shrubs and herbaceous plants.

Standard DIV-3. Avoid the removal or damage to hardwoods that occur within conifer forest types. Exceptions may be allowed to address public safety.

Standard DIV-4. Retain felled green or hazard trees as down wood when existing levels of down wood are below desired levels for the various size or decay classes.

Standard DIV-5. Fall and remove hazard trees within tree falling distance along maintenance level 3, 4, and 5 roads and within or adjacent to administrative sites. Review by an appropriate resource specialist is required prior to falling hazard trees along maintenance level 1 and 2 roads and is generally not appropriate based upon low probably of harm. Retain large felled trees where needed to meet down woody material standards.

Standard DIV-6. Road closure on maintenance level 1 and 2 roads must be considered as an alternative to hazard tree removal in areas where the snags are below desired levels.

Standard DIV-7. All projects must assess the impact on carbon flux (i.e., the measure all carbon pools, including below ground biomass, dead wood, litter, and soil carbon and charcoal) and maintain the forest project area as a resilient carbon pool.

Standard DIV-8. Projects must include actions that facilitate or improve the ability of the forest ecosystem to respond favorably to climate change (e.g., restore and maintain habitat connectivity, maintain genetic diversity, promote species diversity, provide refugia, manage for "asynchrony").

Standard DIV-9. Design projects to reduce potential soil erosion and the loss of soil productivity caused by loss of vegetation and ground cover. Examples are activities that would: 1) provide for adequate soil cover in the short term; 2) allow native early seral vegetation to occur in burned areas; 3) reduce potential impacts of fire on water quality; 4) improve site resilience to repeated fire and drought.

Standard DIV-10. Post-disturbance reforestation projects include the following design measures:

- Plant only large seedless landscapes that were previously a conifer forest type;
- Avoid planting in poor quality planting sites such as rocky slopes, lava caps, or areas dominated by grey pine, blue oak, or chaparral;
- Avoid planting in riparian areas, fens, seeps, springs, and meadows;
- Avoid planting near mature, re-sprouting or young hardwoods, elderberry, or other desired native plants as determined by a wildlife biologist, archaeologist, hydrologist and botanist;
- Use manual removal of competing vegetation immediately around planted conifers and avoid the use of herbicides;
- Allow at least one third to one half of all seedless landscapes to transition naturally through seral stages;
- Group planted conifers in small clusters, not in rows or evenly spaced;
- Use existing roads and skid trails for management purposes;
- Construct temporary roads for reforestation purposes and close these roads following their management use.

Standard DIV-11. Reforestation plans set tree stocking and maintenance guidelines that meet the following criteria:

- Consider all vegetation cover in stocking estimates (not just conifers) including grass, shrubs, other herbaceous plants, and all non-conifer tree species;
- Plant conifers only where there is an ecological basis for establishing a forested landscape within 10-15 years;
- Encourage natural regeneration and succession whenever possible;
- Minimize the connectivity of fuels throughout the development of the planted stand;
- Facilitate the application of prescribed fire throughout the development of the planted stand;
- Minimize the risk of fire spreading from the planted stand to adjacent forest stands;

Standard DIV-12. Do not allow cattle within burned landscapes until:

- Allotment management plans are re-written to address the changed environment and include protection measures for fragile soils, riparian, spring and meadow vegetation, and rare plants;
- Post-fire field assessments for range readiness shall include a determination that the

landscape can support livestock without suffering resource damage;
- There are sufficient staff and resources to continue monitoring and enforcement to avoid resource damage.

Standard DIV-13. Noxious weed assessments, including prevention and eradication measures, are included in every post-fire action including Burn Area Emergency Recovery (BAER) plans, hazard tree abatement, reforestation plans, modification of allotment management plans, and special use permit approval.

Standard DIV-14. The salvage of dead or dying trees following wildfire is limited to activity necessary to address safety concerns on level 2-5 roads and near structures.

Standard DIV-15. Projects and decisions will contribute to the maintenance or restoration of the desired condition for down wood identified during landscape analysis. The removal of down or dead wood greater than 15 inches in diameter is discouraged unless there is high risk to the public or in-woods workers.

Standard DIV-16. Implement mitigation measures when feasible to reduce the risk of losing large live and large dead trees when prescribed burning (Hood 2010).

Standard DIV-17. Projects to restore aspen and other hardwoods shall incorporate mitigation for other stressors identified in the project area, such as grazing impacts on re-established clones or seedlings, poor road placement impacting hydrology and other environmental conditions, off-highway vehicle activities, etc. See Shepard et al. (2006) for aspen management.

D. Regionwide Land Allocations

Table IV.B-1. Land allocation for which objectives for habitat structural and biological diversity differ.

Land Allocation	Definition	Management Objective
Community Zone (CZ)	The area at risk from wildfire directly adjacent to houses or communities and generally not exceeding 0.25 miles from a community.	Create defensible and resilient conditions to protect human life and property. Reduce fuel hazards within 300 feet of structures to significantly limit wildfire effects within this zone. Reduce fuel hazards adjacent to roads providing egress from structures. Suppression would be fire management response Lower priority on meeting structural and biological diversity objectives.
All other land allocations	See Section III.A. for other land allocations	Structural and biological diversity objectives and standards apply to allocations with active management. See Section III.A. for other land allocations.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- None identified

Recommendations for New Regional Direction or Policy

- The Zone Ecologists for the Region should propose tools to support ecologically based decision making and for the design and implementation of restoration projects. Tools, such as marking guidelines for the removal of timber and other vegetation and practical photo-guides highlighting important wildlife attributes to be conserved or enhanced, should be maintained in a living library and shared with forest staff, stakeholders and other interested parties.

- A science review is conducted for the bioregional assessment that evaluates the habitat needs of snag-associated and dependent species in green and burned forests in the Sierra Nevada. This review should be critiqued by an independent panel of scientists in the fields of wildlife and aquatic ecology. The result of this review supports regional direction on snag retention in green and burned forests.

- Provide regional direction on vegetation treatments designed to protect or restore forest structural complexity and promote climate resilience, while protecting biodiversity, species viability, habitat connectivity, natural disturbance processes, and biological legacies such as old trees and snags in the short and long term.

- Evaluate the effects of thinning and burning treatments on vegetation fuels, wildfire hazard, soils, wildlife habitat and use, insect population dynamics, and ecosystem structure and process across fire-dependent ecosystems (Youngblood et al. 2006).

- Investigate the size and shape of fuels treatment units needed to influence wildfire behavior (Hummel and Barbour 2007).

- Develop regional direction and identify priority areas for reforestation. Emphasize reforestation based on climate forecasts (especially for temperature and precipitation) and other important ecological considerations such as importance of protecting riparian and meadow areas during reforestation, importance of reforesting key species such as pinyon pine following large fires because of its significance to wildlife and lack of current nursery stock (Landram 2010, personal communication), and the role of early successional forest composition in forest food webs and ecology.

- Develop regional guidelines for hazard tree marking based on wildlife requirements for Sierra Nevada ecosystems and incorporate into the forest plan to ensure consistency across the region.

- Programmatic reforestation goals recognize that closed canopy forests take a century or more to develop and are not appropriate to recreate by tightly spaced, dense plantations in post-fire early-seral habitats.

- Post-fire grazing allotment modifications are standardized under regional guidance developed by wildlife, rare plant, hydrology, soils and range staff to ensure consistency across the bioregion.

- Funding for the range program should provide for adequate enforcement and monitoring of forest plan standards and allotment management plan direction.

Additional Recommendations

- Request that California Department of Fish and Game make management recommendations during the plan revisions for early seral dependent species such as deer and song birds, sag-associated species such as pileated woodpeckers, secondary cavity nesting species, and old forest-associated species.

Table IV.B-2. Terrestrial special status species associated with early-seral habitats, hardwood, snags, burned areas, and sagebrush in the Sierra Nevada. Abbreviations: **FSSS-** R5 Forest Service Sensitive Species; **BCC**- U.S Fish and Wildlife Service Bird of Conservation Concern; **SAR-** R5 Forest Service Species at Risk (L=low vulnerability, M=moderate, H= high) (USDA Forest Service 2001); **CSSC-** California State Species of Special Concern; **MIS-** R5 Forest Service Management Indicator Species; **TES-** Federally Threatened or Endangered Species; **A-** Audubon California Watch List species; **GS-** Natural Heritage Network conservation status ranking; **WL**- California Department of Fish and Game Watch List Species.

Species	Status	Early Seral	Hardwoods	Sagebrush	Burned Areas	Snags
Flammulated Owl	BCC	X (old forest pine with shrubs)	X (oak)			
Swainson's Hawk	FSSS	X (montane meadow migratory stopovers)				
Greater Sandhill Crane	FSSS	X (meadows)				
Greater Sage Grouse	FSSS, MIS	X (herbaceous cover)		X		
Black-backed Woodpecker	MIS				X	X
Lewis' Woodpecker	BCC		X (oak)			X
Nutall's Woodpecker			X			X
Hairy Woodpecker	MIS					X (old forest, closed canopy conifer)
Williamson's Sapsucker						X
Red-breasted Sapsucker			X (hardwoods, willow in montane meadows)			
White-headed Woodpecker						X (open canopy conifer)
Calliope Hummingbird	A	X (meadows, riparian, or montane chaparral)				
Vaux's Swift	CSSC					X
Wrentit	A	X (chaparral)				

Species	Status	Early Seral	Hardwoods	Sagebrush	Burned Areas	Snags
California Thrasher	A	X (SN foothills chaparral)				
Nashville Warbler		X (montane meadow)	X (oaks with shrubby understory)			
Brown Creeper						X
Mountain Chickadee	WL					X
Fox Sparrow	MIS	X (dense chaparral, or riparian thickets)				
Brewer's Sparrow	CSSC	X (east-side shrublands)		X		
Sage Sparrow	CSSC	X (low dense shrubs, esp. eastside)				
Black-chinned Sparrow	CSSC	X (shublands on eastside)		X		
Lawrence's Goldfinch	A	X (oaks bordering dry chaparral)				
Olive-sided Flycatcher	CSSC, SAR-M					X
Mountain Quail	A, SAR-L		X			
Sierra Nevada Mountain Beaver	CSSC	X				
Dusky-footed Woodrat		X				
Pygmy Rabbit	CSSC, SAR-H	X (dense eastside shrubs, esp. sagebrush)		X		
Sierra Snowshoe Hare	CSSC, SAR-H	X (montane riparian or shrub understory in forests)				
Black-tailed Jackrabbit	CSSC, SAR-H	X				
White-tailed Jackrabbit	CSSC, SAR-H	X (eastside SN)				
Yosemite Pika	GS= T3 vulnerable	X (montane meadow, chaparral, grassland, riparian)				

Species	Status	Early Seral	Hardwoods	Sagebrush	Burned Areas	Snags
Mt. Whitney Pika	GS= T3 vulnerable	X (montane meadow, chaparral, grassland, riparian)				
Gray-headed Pika	GS= T3 vulnerable	X (montane meadow, chaparral, grassland, riparian)				
Badger	CSSC	X (generalist, shrub and grassland)				
Mule Deer		X				
Sierra Nevada Bighorn Sheep	TES	X				
Mt. Lyell Shrew	GS= G2G3-Imperiled	X (montane riparian, grass, willow)				
Pallid bat	FSSS	X (forages in open grassy areas)				X
Long-eared Myotis	CSSC, SAR-M	X (forages along forest edges)				X
Long-legged Myotis	CSSC, SAR-M	X				X
Fringed Myotis	CSSC, SAR-M					X
Silver-haired bat	CSSC, SAR-M					X
Hoary Bat	CSSC, SAR-M	X (roosts in conifer foliage, eats mostly moths, forages along forest edges)				Hibernacula?
Western Red Bat	FSSS	X (forages in open grassland, meadow, open forest)	X (roosts in hardwood foliage)			Hibernacula?
Spotted Bat	CSSC, SAR-M					X (roosts primarily in caves and cliffs, occasionally buildings)
Western Mastiff Bat	CSSC, SAR-M	X (known to forage over meadows)				X (roosts primarily in caves and cliffs, occasionally buildings)

Species	Status	Early Seral	Hardwoods	Sagebrush	Burned Areas	Snags
Townsend's Big-eared Bat	FSSS					X (roosts primarily in caves, occasionally snags and buildings)
Limestone Salamander	FSSS	X (limestone outcrops chaparral)	X (limestone outcrops in oak/grey pine)			
Tehachapi slender Salamander*	FSSS		X (very small population in So.SN; hardwood, grey pine, riparian or mixed-conifer vegetation under leaves and rocks			
Relictual Slender Salamander*	FSSS		X (southern SN in oak/pine or Sierra mixed-conifer)			
Kern Canyon Slender Salamander*	FSSS		X (in Kern River Cyn. in oak/pine or riparian hardwood vegetation			
Kern Plateau Slender Salamander*	FSSS	X Seeps/riparian in otherwise dry sagebrush habitat	X (Seeps/riparian in otherwise dry oak, fir, pinon pine)			
Kings River Slender Salamander*	G1G2: Critically Imperiled		X (in Kings River Cyn. oak/pine or higher-elevation Sierra mixed-conifer)			
Sequoia Slender Salamander*	G1G2: Critically Imperiled		X known only from Kaweah River Cyn. oak/pine or higher-elevation Sierra mixed-conifer			

Range map for all Batrachocepts:
http://www.californiaherps.com/salamanders/maps/sierrabatrachoseps.jpg

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Maintain and Restore Old Forest Habitats and Associated Species

Issue Statement

Old forests are vital components of Sierra Nevada ecosystems. They provide habitat for associated flora and fauna, ecosystem services such as clean water and climate moderation, and they are areas of high social value. Most definitions are qualitative and describe late-seral or late successional stage forests dominated by large trees, malformed trees, snags, and downed logs. They contain more structural diversity within patches, diversity among patches, as well as continuity and wider distribution across the landscape compared to cut-over forests (USDA Forest Service 1998; Stephens and Gill 2005).

There are 22 at-risk vertebrate species and many rare plants such as terrestrial orchids that depend upon old forests (USDA Forest Service 2001a, Volume 4, p. E64). Large old trees provide these species food and shelter. The large canopies often found in old-growth stands provide thermal cover to spotted owls from cold spring storms during nesting (Verner et al. 1992). Older pines also tend to produce more abundant and frequent cone crops (USDA Forest Service 1998), which in turn support tree squirrels and their predators, such as goshawk whose reproduction closely follows the previous year's pine cone crop (Keane 1999).

Old trees provide important habitat structure individually and at the stand and watershed scale. As trees age and become more structurally complex, they develop ecologically important microsites such as cavities, forked tops, broken tops and mistletoe platforms, which provide habitat for many wildlife species (North et al. 2000; Zielinski et al. 2004). Even a single large tree in a young forest can support measurably greater vertebrate diversity than a younger stand by itself (Mazurek and Zielinski 2004). Trees with these elements are lacking in the Sierra Nevada and should be protected where they occur (North et al. 2009). Groups of large trees growing in "clumps" (of 3 or more that are close together) also provide important microsite habitat, and should not be subject to stand density-related marking guidelines. Large trees occurred in groups historically and may not compete for water the same way younger trees do (Hurteau et al. 2007; North et al. 2007).

At the landscape scale, old forests should be managed for fire resilience, water quality, and habitat connectivity. The viability of species such as spotted owl and fisher depend on landscape-scale protection of old forests because these species require large home ranges dominated by dense, old forest habitat for nesting, denning and resting (Verner 1992; Zielinski 2004; North et al. 2009). These wide-ranging species are subject to habitat loss from logging and uncharacteristically large and severe fire (Verner et al. 1992; Spencer et al. 2008). Managed fire is an ideal tool to restore forest resilience to fire and drought, manage stand density, and maintain a heterogeneous spatial pattern that improves habitat quality.

There has been an alarming decline in U.S. forest cover in just the past decade. A recent study quantified global forest loss during 2000-2005, and found that the United States lost six percent of its forest cover (Hansen et al. 2010). Forest loss in North America exceeds that of Brazil, Russia, Indonesia and other countries (Ibid). Similarly, old-growth forests have declined in the Sierra Nevada since the 1860s (Franklin and Fites-Kauffman 1996). The most dramatic losses may have occurred in just the past 20–70 years. Old forest cover in the Sierra Nevada declined approximately 43 percent in just 50 years (Zielinski et al. 2005). During the 1980's the Forest Service was producing over 1 billion board feet of saw-timber annually from the Sierra Nevada, much of it in large old-growth trees. Today roughly 17 percent of forests in the Sierra exhibit late-successional characteristics (Franklin and Fites-Kauffman 1996; USDA Forest Service 2002; Barbour 2002). The amount of forest that has never been logged is far less, perhaps less than five percent (Barbour 2000). Most of the remaining stands have been highly fragmented, with the majority of old growth found over 5,000 feet in elevation, in wilderness reserves, or in steep inaccessible canyons.

Climate change is another threat to old forests. Large tree mortality has doubled in the last 2-3 decades across the West (van Mantegem et al. 2009). This pattern is associated with increases in temperature and droughts, rather than fire history, stand density or insects (Ibid). Climate change only adds urgency to the need to stop old forest decline and fragmentation. Old forest adaptation to climate change depends on a regional restoration strategy with concrete, coordinated actions.

In 1992, public and political pressure forced the Forest Service to stop clear-cutting old growth trees. During the past 15 years, the agency has bolstered protection of its largest and oldest trees, but unfortunately current management guidelines for the Sierra Nevada still leave old forest ecosystems vulnerable to aggressive logging for a variety of reasons, including stand density reduction and financing the removal of smaller, less valuable brush and trees. Current Forest Service management plans for the Sierra Nevada rely on implementation of conservation strategies for species at risk that were never completed or implemented, and promised monitoring that was never accomplished. Maintaining landscape habitat connectivity is inappropriately left up to individual project managers and is rarely addressed at the project level. Furthermore, habitat networks for forest carnivores developed in the 1990s are not consistently being used. Old forest habitat connectivity is an essential part of old forest restoration that should be a higher priority in the region. This habitat should also be protected and managed to increase over time, free from economic pressure to serve as a source of funding. The Forest Service has generally backed away from treating old forest areas as ecological units deserving distinct ecological management, contrary to the best available science (USDA Forest Service and USDI Bureau of Land Management 1994, Franklin et al. 1996).

Restoration goals for these forests should allow natural disturbance agents to occur (Youngblood et al. 2006). Fire, insects and disease are key processes that help maintain important structure in old forests (Spies et al. 2006). A number of other authors describe natural disturbance regimes in old forests. These descriptions are summarized in Appendix C in order to understand and restore the natural range of variability for various functions and components of these systems.

Restoring old forests in the Sierra Nevada must also entail protection of the smaller cohorts of trees in the 20-30 inch diameter size-class to someday replace large trees, snags and logs. This becomes crucial in stands where the larger tree component has been logged and large trees, snags and logs are already missing from much of the landscape (North et al. 2007, North et al. 2009).

In summary, actions to protect and restore old forest conditions should be integrated with efforts to increase habitat connectivity, restore ecological processes such as fire disturbance and water purification, restore structural diversity, and reduce risk to species associated with old forests. There is great value in protecting large blocks of old forest habitat (USDA Forest Service 2001a, Volume 4, p. E-47), as well as remaining smaller patches and even individual trees. The best management strategy to maintain and expand old forests will prioritize delineation, connectivity, and explicit protection of structural elements at multiple scales (USDA Forest Service 1998). Disturbance regimes including fire, insect outbreaks, and disease are all important in creating complex forest structure (USDA Forest Service 1998). These processes should be allowed to operate within the natural range of variability. The forest plan revision is a strategic process to ensure lasting protection and proliferation of these rare yet essential habitats.

Policy Actions Needed

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition OF-1. Late-successional forests are well represented on the landscape and their distribution is driven by the range of variation of landscape patterns, disturbance processes, and interaction with climate change (Spies et al. 2006).

Desired Condition OF-2. Large, old decadent trees are well distributed throughout the landscape.

Desired Condition OF-3. Periodic disturbance resulting from natural events (fire, insects, disease, flooding) occurs at frequencies and scales that are appropriate for the vegetation type, soils, climate and geography of the site

Desired Condition OF-4. Late-successional forests are resilient to changing climatic condition, have the capacity to maintain natural ecosystem function, and provide a resilient carbon pool.

Desired Condition OF-5. The number of large snags and downed wood supports old forest-dependent species and protects and enhances soil productivity.

Desired Condition OF-8. Late successional and old-growth forests are inhabited by the full complement of species associated with or dependent upon these forests.

Desired Condition OF-9. High quality habitat for old-forest associated wildlife (such as California spotted owl, Northern goshawk, great gray owl, fisher, marten, Sierra Nevada red fox and wolverine) includes habitat to support their preferred prey species as well as mature forest to support productive breeding and rearing. Each of these species is well distributed throughout its historic range.

B. Objectives

Objective OF-1. Old forest emphasis areas are specifically designated and managed to protect and restore old forest conditions and support movement of associated species.

Objective OF-2. Stand-level structural definitions and density thresholds distinguish old growth that is maintained by frequent surface fires from more mesic or high-quality growing sites where old growth develops under long periods without fire (Spies et al. 2006 and 2004).

Objective OF-3. Ensure habitat connectivity for old forest associated species by managing large contiguous areas of late-successional forest linked by high capability habitat for dispersal (Franklin et al. 1996).

Objective OF-4. Fuel connectivity is interrupted by fuel reduction areas that create ecologically based heterogeneity to sustain old forest habitat for wildlife and promote resiliency of forests in the face of disturbance and climate change (Spies et al. 2006).

Objective OF-5. Identify areas for acquisition, exchange, or conservation easements to enhance connectivity of habitat for old forest associated species.

Objective OF-6. Maintain 50 percent of national forest lands in old forest conditions, with at least 30 percent of old forest patches providing dense, multi-layered canopy or other attributes appropriate to the forest type for old forest associated species.

C. Standards

Standard OF-1. Landscape analyses must specifically address the protection and restoration of old forest conditions and recommended actions are integrated with efforts to increase connectivity, restore ecological processes, restore structural diversity, and reduce risk to species associated with old forests.

Standard OF-2. Create non-activity zones around snags and logs in active timber harvests to protect these ecological attributes and worker safety (Wisdom and Bate 2008).

Standard OF-3. Retain felled green or hazard trees as down wood when existing levels of down wood are below desired levels (e.g., sizes, amount, decay classes).

Standard OF-4. Limit access for firewood cutting to lessen snag loss in areas where snag standards are not met, and where valuable wildlife habitat should be protected (Wisdom and Bate 2008).

Standard OF-5. Implement the conservation measures in project level decisions for species at risk associated with old forests such as California spotted owl, goshawk, great gray owl, marten, fisher, Sierra Nevada red fox, and wolverine identified in Appendix A.

Standard OF-6. Identify old forest stands with continuous and dense fuel loading, and take measures to reduce fuel loads prior to reintroducing fire (Vosick et al. 2007).

Standard OF-7. Limit fuel reduction treatments in old forests or late-successional forests to reducing surface and ladder fuels with a focus on removal of shade-tolerant conifer trees (North et al. 2009).

Standard OF-8. In watersheds currently providing less than 20 percent suitable owl, goshawk and forest carnivore nesting and denning habitat, maintain all existing nesting/ denning habitat (USDA Forest Service 2001b) and do not degrade existing habitat conditions.

Standard OF-9. Land management activities in Old Forest and Connectivity (OFC; land allocation see Table IV.C-2) shall be designed to enhance, restore and not degrade high quality late-successional conditions.

Standard OF-10. On dry sites, maintain at least 40 percent canopy cover with at least 30 percent of treated forests retaining multiple canopy layers. On mesic sites, maintain at least 70 percent canopy cover with at least 30 percent of treated forests retaining multiple canopy layers. (USDA Forest Service 2001b).

Standard OF-11. Follow the vegetation management standards in the section on “Planning and Integration” (III.A., Standard PLAN-4).

Table IV C-1. Species associated with old forest habitats for which standards and conservation measures have been included in Appendix A.

Scientific Name	**Common Name**	**Reason for Inclusion**
Martes americana	American marten	Species at risk
Martes pennanti	Pacific fisher	Species at risk
Gulo gulo	Wolverine	Species at risk
Strix occidentalis occidentalis	California spotted owl	Species at risk
Strix nebulosa	Great gray owl	Species at risk
Accipiter gentilis	Northern goshawk	Species at risk
Dryocopus pileatus	Pileated woodpecker	Species of interest

D. Regionwide Land Allocations

Table IV.C-2. Land allocations targeting old forest systems and associated species.

Land Allocation	General Description	Management Objective
Protected Activity Center (PACs)	Designation around known nesting sites for California spotted owl (300 acres), northern goshawk (200 acres), and great gray owl (50-200 acres). Inclusion in PAC of area within 300 feet of structures is avoided.	Provide habitat conditions to support successful reproduction.
Home Range Core Area (HRCA)	Area around California spotted owl nest site and including the PAC. Size ranges from 600 acres to 2,400 acres depending on location in the Sierra Nevada.	Provide for high quality foraging habitat near to nest stands.
Forest Carnivore Den Sites	Den site buffer (700 acres for fisher; 100 acres for marten) designated around known maternal or natal dens.	Limit disturbance during denning (limited operating period). Retain habitat conditions that support denning. Limit vegetation management to reducing surface and ladder fuels to reduce fire risk until new science suggests otherwise. Restoration treatments do not remove larger WF/IC in these areas.
Old Forest and Connectivity (OFC)	Area in which old forest qualities are emphasized. Area critical to the movement and flow of species associated with all habitat types across the landscape. Designed as an adaptation to climate change and other stressors.	Restore ecological process where doing so does not threaten critical values. Maintain movement opportunities across the landscape.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Restrict use of rodenticides at facilities approved under Special Use Permits and other Forest Service facilities.
- Work with state and county transportation agencies to improve wildlife passage on high use or high risk roads. Consider the following practices in a comprehensive program: 1) wildlife friendly road crossings, e.g., tunnels, culverts, overpasses; 2) vehicle speed control; 3) educational programs.
- Restrict outdoor feeding and free roaming of domestic pets at Special Use Permitted facilities and other Forest Service facilities.

Recommendations for New Regional Direction or Policy

- Evaluate the status and trend of old forest conditions since the Sierra Nevada Ecosystem Report (1996) by the end of 2012 (2009 RF letter). This forest ecology research summary should define the range of variability of stand density, mortality, as well as extent and intensity of natural disturbances (insects, disease, and fire of all intensities) in several common Sierra Nevada forest types.

- Forest plans shall incorporate analyses and recommendations from a science team evaluation of old forest associated species status and trends. Implement science-based conservation strategies for them before forest plans are finalized (2009 RF letter).

- Provide a framework for developing desired conditions for old forests for each forest to use in guiding plan development.

- Direct the adoption of an integrated and consistent approach to management of old forest types among national forests.

- Develop regional guidance for protecting old forest associated species and their habitat (including improving landscape connectivity).

- Develop regional guidance on snag retention and protection for green timber sales, salvage and hazard tree sales according to range of natural variability in old forests.

- Focus the allocation of funds from the Regional level to the national forest level on treatments that will increase forest resilience while enhancing wildlife habitat (same as fire section).

- Fire management policy and Forest Service leadership support biodiversity and ecosystem function through the use of prescribed burning and natural fire (Odion et al. 2009) (same as fire section).

- Continuing education emphasizing emerging knowledge of forest ecosystems should be encouraged for land managers (Vosick et al. 2007).

Additional Recommendations

- State and federal forest managers and state and federal wildlife managers should design conservation measures together to retain key wildlife habitat features (Bunn 2007).

Table IV.C-3: Old Forest-Associated Species at Risk in the Sierra Nevada (USDA Forest Service 2001, USDA Forest Service 2007, California Department of Fish and Game 2011).

Species	Protection Status
American Marten	FSS, CSSC, MIS
Bald Eagle	FSS
Band-tailed Pigeon	SAR-M
Black Bear	SAR-M
California Condor	FE, CE, CFP
California Spotted Owl	FSS, MIS
Flammulated Owl	ACWL, BCC
Fringed Myotis	CSSC / SAR-M

Species	Protection Status
Great Gray Owl	FSS, CE
Harlequin Duck	CSSC
Horay Bat	CSSC / SAR-M
Long-eared Myotis	CSSC / SAR-M
Long-eared Owl	CSSC
Long-legged Myotis	CSSC / SAR-M
Mt. Pinos Sooty Grouse	CSSC
Northern Flying Squirrel	MIS
Northern Goshawk	FSS
Olive-sided Flycatcher	SAR-M, CSSC, ACWL
Osprey	WL
Pacific Fisher	FSS, FWBP, CSSC
Pallid bat	FSS
Sharp-shinned Hawk	WL
Sierra Nevada Red-fox	FSS, CT
Silver-haired bat	CSSC / SAR-M
Sooty Grouse	MIS, SAR-M
Townsend's/Pacific Western Big-eared Bat	FSS
Vaux's Swift	CSSC
Western Red Bat	FSS
Wolverine	FSS

FSS- R5 Forest Service Sensitive Species
SAR- USFS R5 Forest Service Species at Risk (M=moderate vulnerability, H= high vulnerably)
CSSC- California State Species of Special Concern
FE- Federally Endangered Species
WL- California Department of Fish and Game Watch List Species
MIS- Management Indicator Species
CT- California Threatened
FWBP- Federal "Warranted but Precluded"
CFP-California Fully Protected
AWCL- Audubon California Watch List Species

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RESTORE AND MAINTAIN AQUATIC ECOSYSTEMS

ISSUE STATEMENT

Sierra Nevada watersheds provide as much as 65 percent of freshwater used by California's population (Timmer 2003) and constitute the single greatest benefit to the State Economy (Goldman 2000). If healthy, Sierran watersheds can also provide a wide array of ecological goods and services that are critical to local and distant human populations *as well as* native flora and fauna. The chemical, physical and biological integrity of aquatic ecosystems[1] is the core element of watershed function and resilience. In addition to water storage and delivery, the lakes, rivers, streams, springs, seeps, wetlands, floodplains, meadows, and fens of the Sierra support a range of landscape processes and provide critical habitat for a diverse assemblage of biological communities and species. Meadows, for example, serve to recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitat for wildlife (Loeb 1994). Flood plains provide critical forage for fish and other aquatic species that have evolved in conjunction with the dynamic flood pulse, while their dynamic hydrology and geomorphology creates heterogenous habitats supporting rich biodiversity and bioproduction (Tockner et al. 2000). The collective aquatic habitats of the Sierra Nevada and Cascade ranges support 61 fish species and 37 amphibians (California Department of Fish and Game 2007). Of these, there are 40 species of fish native to the Sierra Nevada, 11 of which are endemic (Moyle et al. 1996). The Institute for Bird Populations estimates that there are 37 species of birds in the Sierra Nevada that are either critically dependent or strongly associated with montane meadows (Siegel and DeSante 1999).

Maintaining ecological resiliency is critical to the long-term health of aquatic, ecosystems and the larger watershed processes and biotic communities they support. Healthy aquatic ecosystems can quickly become degraded when their ability to functionally respond to perturbations is compromised, and as such, can serve as early indicators for potential larger scale watershed change or degradation. Lakes, for example, act as sentinels, providing signals that reflect the influence of climate change in their broader catchments (Williamson et al. 2008, Williamson et al. 2009).

In the Sierras, aquatic ecosystems are recognized as being one of the most degraded of all ecosystem types (Centers of Water and Wildland Resources 1996). Twenty-four percent of the native fish in the Sierra Nevada are listed as threatened or endangered under federal or state endangered species acts, 26% were found to be in danger of extinction in the near future, and another 26% were vulnerable to extinction if present declining trends continue, 26% were in decline, and only 17% were found to be relatively stable (Moyle et al., 2008, Moyle et al. 2011). Fifty percent of native amphibians were already at risk of extinction well over a decade ago (Jennings 1996). Current trends suggest there is an urgent need to proactively address the threats to aquatic ecosystems throughout the Sierra Nevada in order to preserve the critical ecosystems, species and resources they support (California Trout 2008, Derlet et al, 2010).

Threats to Aquatic Ecosystems

Primary threats to aquatic ecosystems in the Sierra include poorly managed grazing, improperly designed and/or placed road systems, invasive species, excessive water withdrawal; timber harvest and tree removal in and around aquatic habitats, and erosion and sedimentation from fire, all of which are potentially exacerbated by the effects of climate change.

[1] Aquatic ecosystem types generally fall within three distinct categories: (1) Lentic-comprised of slow moving water, including pools, ponds and lakes, (2) Lotic- comprised of rapidly-moving water, for example streams and rivers and (3) Wetlands-areas where the soil is inundated or saturated for at least some portion of time.

Poor grazing practices can result in a series of negative impacts to aquatic resources (Derlet 2010). Hyper-eutrophication can occur resulting from excessive deposition of manure which in turn marginalizes nutrient dynamics associated with water. When compared to ungrazed areas of the southern Sierra, grazed areas have been shown to have negative impacts on native trout (Knapp and Matthews, 1996). Poor grazing practices have also been shown to negatively impact riparian vegetation stream bank structure, and channel morphology which in turn affects water temperature and quality, as well as aquatic habitat community structure and food-web dynamics. With proper management, grazing can be less detrimental to riparian ecosystems.

Improperly designed, maintained and/or placed road systems and elevated road densities all have negative physical and biological impacts on aquatic ecosystems, particularly hydrologic processes and water and substrate quality via sedimentation (Furniss et al. 1991, Trombulak and Frissell 2000, Gucinski et al. 2001). Roads often constitute the primary sediment source as well as comprising much of the surface with a higher degree of imperviousness, resulting in increased runoff, and accelerated slope failure and land sliding on many slope types (Montgomery 1994, Gucinski et al. 2001). The most prevalent and critical cause of harm from forest roads to Sierran streams is the chronic and/or episodic injection of road runoff into surface waters from both upland and riparian roads. Roads that should be identified as a high priority for decommissioning include roads built in riparian areas, on steep inner gorge slopes, across unstable or highly erodible soils, in tributary canyons where stream crossings and steep slopes are common, roads with high short-term or long-term maintenance costs and requirements, and abandoned roads containing large or numerous sediment delivery sites.

Recreation, while often considered a benign activity on National Forest lands, can negatively impact aquatic ecosystems in a number of ways. Depending on the site, unmanaged off-highway vehicle (OHV) use in the national forest can have serious impacts on land and water, among them: (1) damage to wetlands and wetland species, (2) severe soil erosion and compaction, (3) destruction of streambank vegetation and habitat (4) stream sediment deposition and (4) spread of invasive species. Off-highway vehicles and the use of combustion engines also pose threats from the associated potential for igniting fires. To a lesser degree, depending on the intensity of use, pack-stock animals pose similar threats as OHVs. Less intrusive recreational activities such as dispersed camping within meadows or along riparian corridors, mountain biking and even hiking that involves crossing of creeks and other waterways potentially threaten elements of aquatic ecosystems resulting from sedimentation and damage to stream banks and riparian vegetation.

Invasive species have the capacity to negatively impact native flora and fauna through aggressive direct and indirect competition, and direct predation altering food web dynamics, as well as through significant alterations to critical habitat. Additionally, invasive species can displace native and/or naturalized species as a result of hybridization. Invasive species can degrade natural resource aesthetics, recreational opportunities and water related infrastructure resulting in significant economic challenges.

Over-exploitation of fresh water for human consumption results in excessive diversions of freshwater, negatively impacting water quality parameters essential for aquatic flora and fauna. For example, water diversions can contribute to increased water temperatures as a result of lower instream flows. In some cases where water diversions prevent or significantly modify a previously unimpaired river system, such diversions can inhibit flushing flows that support geomorphic processes as well as transporting sediments further down stream. In other cases, dewatering of river and creek systems has resulted in an absolute loss of fisheries resources altogether (e.g., Mono Basin). The human demand for water has also resulted in the construction of storage facilities (e.g., dams), and in doing so eliminated fish passage necessary for fundamental life-cycle stages and the basic wellbeing of affected flora and fauna.

Riparian logging can result in direct and cumulative adverse impacts. Although thinning is often portrayed as ecologically benign or restorative, there is little support in the scientific literature to conclude as a general matter that logging or mechanical removal of vegetation in riparian areas will achieve aquatic restoration goals. Due to the highly degraded status of many Sierra streams and their riparian areas, coupled with the reality of restoration thinning projects that have been inadequately justified and are likely inconsistent with protection of aquatic resources, we recommend that additional direction be provided in the forest plan to clarify when near-stream disturbance is appropriate.

Forest thinning that is primarily intended to reduce fuels and attenuate fire behavior, change forest stand species composition, or accelerate tree growth, is often inconsistent with aquatic and riparian ecosystem conservation and recovery. As a general rule, thinning along streams that goes beyond "light touch" removal of fuels to allow for the safe application of prescribed fire is neither ecologically necessary nor beneficial from an aquatic protection and restoration perspective (Frissell et al. 2012). More intensive actions to "restore" stream environments are rarely justified by the claimed benefits of accelerated growth of remaining trees or the eventual recruitment of large wood to streams when weighed against the immediate impacts of wood removed, delayed senescence, direct and delayed impacts of the treatments themselves on soils and sediment, and concomitant watershed-wide impacts of building, rebuilding, or operating on logging roads to do the work.[2] In terms of setting priorities for aquatic and riparian restoration—given competition for scarce watershed restoration resources—the best available science indicates that watershed restoration actions focused on the reintroduction of fire and other disturbance processes (e.g., flooding), road storm-proofing, and decommissioning have far more certain and direct benefits and far fewer risks for aquatic ecosystems.

Climate change scenarios include predictions for increased stream water temperatures. If warming stream temperatures reach critical thresholds, the health and viability of fish and other aquatic species can become threatened (Thompson et al 2011). As stream temperatures increase, a more conducive environment for the introduction of invasive species as well as other undesired aquatic vegetation and potentially toxic algae will be realized (Coats et al. 2006). In a related manner, climate change also has direct implications on timing of hydrologic processes and in particular, shorter duration but more intense precipitation patterns. As a result of changing climatic patterns, snowmelt will occur in shorter periods resulting in lower late-summer/early-fall flows when ambient air temperatures are at their peak.

[2] As NOAA-NMFS has noted, riparian thinning is only a potential benefit "where there is already sufficient instream wood already present to provide habitat functions during the lag between thinning a forest and recruitment of logs from the thinned forest to the stream, and where existing trees are too small to form pools when they fall into streams." (NMFS 2008, page 8). This is a rare situation, however, because research shows that small trees are effective and in fact critical to forming pools in smaller streams, citing e.g. Beechie et. al. 2000. Id. NMFS further finds there is no scientific basis to contend thinning outside 100 feet can't decrease steam shading (a contention we have seen made to justify riparian thinning) or that less shade than that provided by natural site-potential conditions is required to meet aquatic ecosystem needs. Id. at 14. The US Environmental Protect Agency ("USEPA") has concurred with these and other concerns about riparian thinning (USEPA 2008).

Mandate to Maintain and Restore Aquatic Health

The threats noted above are clear and present dangers that require actions on the part of state and federal land management agencies. As the single largest land manager throughout the Sierra Nevada[3] it is incumbent upon the Forest Service to proactively mitigate such threats in the forthcoming revisions to the forest plan for national forests in the Sierra Nevada. Specifically, the revised forest plans should adequately address ecosystem protection, restoration and maintenance in the following ways:

- Maintain native biodiversity, and biotic community structure and function within and adjacent to aquatic ecosystems
- Protect and restore meadow and riparian habitats
- Protect ecosystem resiliency and functionality by maintaining physical, chemical and biological processes as well as associated landscape dynamics (connectivity, heterogeneity, succession, disturbance) supporting aquatic ecosystems
- Establish thresholds for key biological, physical, and ecological parameters as indicators for ecosystem integrity
- Establish and implement adequate monitoring and evaluation protocols to ensure the integrity of aquatic systems and enable effective ongoing stewardship within an adaptive management context
- Ensure protection of critical habitat, resource areas and the associated listed flora and fauna at adequate ecological scales

Fortunately, there are recent planning directives that could be used together to effectively accomplish the needed protection and restoration of aquatic systems. We describe below three of these directives.

[3] The U.S. Forest Services manages 47% of the entire Sierra Nevada, compared to roughly 6% and 10% of lands managed by the National Parks Service and the Bureau of Land Management respectively and 31% privately owned.

2012 Planning Rule

Regulations were adopted in early 2012 that provide specific direction to protect and restore aquatic systems. Overall, the rule elevates the importance of aquatic and riparian resources and the maintenance and restoration of watershed resiliency as a priority for Forest Service management. There are significant requirements that support aquatic conservation in the new planning rule (36 CFR 219), including:

- The identification in revised plans of watersheds that are a priority for maintenance and restoration;
- The structure and function of “Aquatic Ecosystems and Watersheds” must be maintained and restored; the rule specifically states that standards and guidelines must be adequate to maintain and restore water quality and water resources;
- Riparian Area Standards and Guidelines and other plan components must be adequate to maintain or restore “ecological integrity” of riparian areas, direction which goes beyond the need to meet Clean Water Act standards;
- Plan components to protect and restore the ecological integrity of riparian areas must take into account the following 6 attributes: water temperature/chemical composition; blockages; sediment deposits; aquatic and terrestrial habitats; ecological connectivity; restoration needs and floodplain values/risk of flood loss;
- Requirement that riparian management zone widths be established for all lakes, perennial and intermittent streams, and open water wetlands; and
- Establishes a definition of riparian management zone which makes clear that the primary emphasis for these zones is to “maintain or restore riparian functions and ecological functions.”

Watershed Condition Framework

The Watershed Condition Framework ("WCF")(USDA Forest Service Watershed Condition Advisory Team, 2011) was adopted by the Forest Service in mid 2011. This program lays out a six-step process whereby all 6th-field watersheds (10,000 to 40,000 acres) will be classified according to their condition and prioritized for restoration according to watershed action plans. Implementation will be tracked and monitored. Condition class is determined according to a standardized process that employs 12 metrics (Potyondy et al. 2011) that are aggregated to generate a single index of watershed condition that places every watershed in one of only three categories: *functioning*, *functioning at risk* or *impaired*. In general, the individual metrics are more informative about restoration needs than the index itself, and additional watershed-specific information is needed to craft management actions that effectively address aquatic restoration priorities. Although not a perfect system (see Scurlock and Frissell 2012 for additional discussion), the process raises the profile of watershed condition nationally and compels Forests to concentrate their restoration resources in specific watersheds for maximum effect. Specifically, it makes a direct connection between watershed condition, threats to watershed health and a specific program of work, i.e. "essential projects." The initiative also encourages collaboration and partnerships to leverage resources and achieve restoration goals.

Using the WCF, twenty-four priority watersheds have been selected for the eleven national forests in the Sierra Nevada.[4] Initial Watershed Actions Plans were developed in 2011 (e.g., FY2011 Transition Watershed Restoration Action Plan, Oak Creek Watershed, Mt. Whitney Ranger District, Inyo National Forest[5]).

Travel Management Planning: Subpart A

Subpart A of the Travel Management Rule requires each national forest unit to complete a Travel Analysis Report, identify and map the minimum necessary road system and list unneeded roads (36 CFR § 212.5(b) and implementing guidance at FSH 7709.55, Chapter 20). The link between the condition of the road system and aquatic health is undeniable. Because of this essential connection, these three assessment and planning processes must inform each other. For the Sierra Nevada, it appears for many of the Watershed Restoration Action Plans have taken the step to integrate travel planning with the WCF process (Scurlock and Frissell 2012). Moreover, as identified by Scurlock and Frissell (2012), "Travel Analysis, and effective decision-making about road system and watershed restoration, itself need to be informed by four strings of knowledge drawn together: 1) the environmental costs, damages and risks associated with particular routes and segments, and 2) the cost of maintenance to acceptable environmental and traffic standard of particular routes and segments, 3) the cost of decommissioning them, and 4) the strategic importance of particular routes and segments to support forest uses.

We find that the forest plan is the best fit as a planning level for the integration of WCF, travel management planning and other resource planning. Such an approach would address both the programmatic need and the ecological effectiveness of integration across affected programs and services (Scurlock and Frissell 2012). The revision process offers the best opportunity to complete a systematic analysis, make strategic decisions, and execute the watershed protection and restoration duties under the 2012 planning rule.

[4] http://www.fs.fed.us/publications/watershed/ and http://www.fs.fed.us/publications/watershed/maps/R05_WCC_FS_Lands_v2.pdf

[5] http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5343812.pdf

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

We believe that it is essential for revised forest plans to include an aquatic conservation strategy that is well integrated to upland ecosystems. Accomplishing this integration is not a simple task. Similar to past direction in Region 5 (USDA Forest Service 2004) and Region 6 (USDA Forest Service 2008), we propose the adoption of the following elements to support an integrated strategy that evaluates aquatic resources and implements protective and restorative actions.

Landscape analysis: This is a process to evaluate baseline conditions and set the context for restoration; it incorporates WCF information, travel planning analysis, and establishes priorities for action over a large scale (10,000 to 50,000 acres areas). This analysis provides the context and factual support for cumulative effects analysis and includes the results of various evaluations – e.g., estimates of equivalent roaded acres and stream condition surveys – to identify and prioritize restoration measures needed to maintain and restore aquatic resource conditions. Landscape analysis is also discussed in Section II.A. Planning and Integration of this strategy document.

Aquatic Diversity Emphasis (ADEs): These are watersheds identified for their high quality and function (Moyle et. al. 1996, Williams and Spooner 1998). Management direction in these areas is designed to ensure that aquatic resource protection and restoration are the primary outcomes, with minimal risk of offsetting harms from active or extractive management (Scurlock and Frissell 2012). Actions proposed within ADEs must be designed to meet the stated Riparian Conservation Objectives (RCOs). This designation is similar to the "Key Watersheds" adopted by national forest in Region 6 (USDA Forest Service 2008).

Riparian Conservation Areas (RCAs): Default buffers are established to ensure protection of riparian areas and associated uplands.These buffers are not ecotypes and include lands adjacent to perennial, intermittent, and ephemeral streams, meadows and marshes, other areas of near surface water influence, and groundwater-dependent ecosystems such as marshes, springs and fens. Revision of the default buffers is allowed following site specific analysis. Actions proposed within RCAs must be designed to meet the stated RCOs.

Species refuges: Specific land allocations are proposed to protect and restore specific at-risk species dependent upon riparian and aquatic ecosystems. The recommendations are provided in Section IV. E. Conservation of Species at Risk and Appendix A.

Objectives and Standards: These elements set the direction for protection and restoration.

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Watersheds, the complex of rivers, streams, lakes, meadows, bogs, fens, wetlands, vernal pools, and springs, that comprise their networks, and the ecosystems they support function based on a suite of naturally occurring characteristics, features, processes, and dynamics. This assemblage maintains the physical and biological integrity of these nested systems, including water quality, stream channel stability, critical aquatic habitat, and biotic community structure. The integrity of these systems is the basis for their ability to respond and adjust to disturbances without long-term adverse changes. Desired conditions are those which maintain watershed integrity and promote resilience, at a range of spatial and temporal scales. Desired conditions should be 1) described relative to one or multiple appropriate reference sites or conditions, 2) monitored for inter- and intra-annual variability and 3) adaptively managed to attain achievement.

Physical processes and dynamics

Desired Condition AQ-1. Physical (e.g., geomorphic, hydrologic) connectivity is maintained and associated surface processes (e.g., runoff, flood-pulse, in-stream flow regime, erosion, sedimentation, mass wasting) are functional.

Desired Condition AQ-2. In-stream, overland, and groundwater flows and natural storage (e.g., lakes, wetlands, aquifer, snowpack) operate based on a natural flow regime (including pattern, timing and flux rate of annual, seasonal, and daily maximum, minimum and mean flows) that is sufficient to provide for geomorphic maintenance of aquatic landscape, habitat structure, and ecosystem function.

Desired Condition AQ-3. Corridors and passage ensure that existing aquatic habitat and species fragmentation as a result of physical barriers or habitat alterations (e.g., temperature changes, loss of stream flow, non-native species predations/hybridization) does not exclude species from their historic habitat, or diminish historic range size.

Habitat

Desired Condition AQ-4. Critical habitat features and functionality are maintained to provide for the needs of all aquatic-dependent target species and species of concern.

Desired Condition AQ-5. Water quality is maintained across all aquatic habitat types meeting or exceeding state EPA water quality standards for designated use.

Desired Condition AQ-6. Sediment load and turbidity, as a component of water quality, are within the tolerance ranges of all target species as well as below established thresholds and within reference ranges. Potential drivers of increased sediment load (e.g., soil compaction, impervious surface, increased runoff) are monitored and mitigated. Specifically:

- Pollutants and nutrient load, as a component of water quality, are below the threshold for all adverse effects for all target species and productivity levels, and potential point and non-point sources of increased pollutants or nutrient load (e.g., cattle, wastewater, industry, mine drainage) are monitored and mitigated.
- Light, temperature, dissolved oxygen, and pH as components of water quality are within the tolerance ranges of all target species as well as below established thresholds and/or within reference ranges; and potential drivers of change to physical water quality (diversions, dams, levees, withdrawal, nutrient loading, upland land use, etc.) are monitored and mitigated.

Desired Condition AQ-7. Lotic aquatic habitats retain all of the necessary and appropriate attributes (including but not limited to adequate vegetation, landform, large woody debris, sediment load and quality) to function properly and support native biotic communities by: 1) dissipating stream energy associated with high water flows, 2) filter sediment, 3) capture bedload and aid floodplain development, 4) improve flood-water retention and ground-water recharge, 5) develop root masses that stabilize streambanks against cutting action, and 6) develop diverse ponding and channel characteristics to provide the habitat, water depth, duration and temperature necessary for greater biodiversity.

Desired Condition AQ-8. Lentic aquatic habitats retain all of the necessary and appropriate attributes (including but not limited to adequate vegetation, landform, large woody debris, sediment load and quality) to function properly and support native biotic communities by: 1) dissipating energies associated with wind action, wave actions, and overland flow from adjacent sites, 2) filtering sediment and aiding floodplain development, 3) improving flood-water retention and ground-water recharge, 4) developing root masses that stabilize islands and shoreline features against cutting actions, 5) restricting water percolation and 6) developing diverse ponding characteristics to provide the habitat, water depth, duration and temperature necessary for fish production, waterfowl breeding, and greater biodiversity.

Desired Condition AQ-9. The ecological status of meadow vegetation is late seral (50 percent or more of the relative cover of the herbaceous layer is late seral with high similarity to the potential natural community). A diversity of age classes of hardwood shrubs is present and regeneration is occurring.

Biota and biotic communities

Desired Condition AQ-10. Aquatic habitats support well distributed, self-sustaining, and genetically diverse populations of appropriate native fauna, including species of concern, target species, and indicator species (vertebrates and invertebrates), relative to established reference sites and conditions.

Desired Condition AQ-11. Aquatic habitats support well distributed, self-sustaining, and adequately genetically diverse populations of appropriate aquatic algae, phytoplankton, macrophytes, riparian herbaceous and woody vegetation, and upland chaparral and forest species.

Desired Condition AQ-12. The full range of aquatic ecosystem types including physical habitats, habitat features, biotic communities, species, and associated processes, functions, and ecological interactions, are restored relative to established reference conditions including:

- Recovery of threatened, endangered, and sensitive aquatic and riparian-dependent species.
- Prioritization and conservation of remaining native aquatic species, native community strongholds, and high quality habitats.
- Improvement or maintenance of appropriate geomorphic and hydrologic conditions to support the needs of the physical habitat and biotic community

Management and stewardship

Desired Condition AQ-13. Watersheds, at all scales, are managed to restore and maintain native biotic communities, across all appropriate taxonomic groups and trophic levels and regardless of species listing or status.

Specific to Aquatic Diversity Emphasis (ADE) Watersheds

The general desired conditions for aquatic ecosystems apply in the RCAs and ADEs. In addition, the following desired conditions are applicable to the ADE land allocation.

Desired Condition AQ-14. ADEs exhibit natural streamflows, and dams and diversions are not present.

Desired Condition AQ-15. Aquatic organism passage is not impaired by road stream crossings except where barriers are necessary to protect native species from invasion by nonnative species.

Desired Condition AQ-16. ADEs are withdrawn from mineral entry.

Desired Condition AQ-17. Road density is 1.5 mi per mi^2 or less and the existing road density does not increase over time.

B. Objectives

The following objectives were adapted from USDA Forest Service and USDI Fish and Wildlife Service (1995) and recommendations in Scurlock and Frissell (2012).

Quantitative

These objectives are not intended to represent fixed threshold levels. They are intended to provide the basis from which to develop objectives that best fit the site, reach or subwatershed scale (USDA Forest Service 2001, Appendix I, p. 102).

Applicable to Low Gradient Streams (<2%) and Banks Comprised of Fine-Textured Material

Objective AQ-1. Upward trend in bank angle, with target of 100 degree average for reaches. Maintain streambanks to ensure protection of aquatic systems to which species are uniquely adapted.

Objective AQ-2. Upward trend in bank stability, with target of 90% stability for reaches.

Objective AQ-3. Upward or stable trend in width-to-depth measures, as compared to reference stream data, measured at flat water habitat types.

Objective AQ-4. Target is upward trend in vegetation, to target age classes, structural diversity and cover representative of good condition for the vegetative community.

Objective AQ-5. Target is connectivity evident on 90% of all alluvial reaches. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Generally Applied to Streams and RCAs

Objective AQ-6. The shade obtainable in the RCA is stable or trending upward relative to the potential natural vegetative community.

Objective AQ-7. Levels of large woody debris reflect potential natural condition in terms of frequency and distribution and mimic natural conditions. Large woody debris is sufficient to sustain physical complexity and stability.

Objective AQ-8. Establish acceptable proportions of fines within a pool tail using the following guidance (USDA Forest Service and USDI Fish and Wildlife Service 1995):

- Mainstem<10%
- Tributaries in non-rhyolitic soils <15%
- Tributaries in rhyolotic soils <20%

Objective AQ-9. Establish acceptable levels of embeddedness at riffles and pool tails using the following guidance (USDA Forest Service and USDI Fish and Wildlife Service 1995):

- Mainstem <10%
- Tributaries in non-rhyolitic soils <15%
- Tributaries in rhyolotic soils <20%

Objective AQ-10. Residual pool depth does not decrease over time due to management activities.

Objective AQ-11. Temperature does not increase beyond reference/historical values due to management activities.

Objective AQ-12. The target for large wood recruitment is an upward trend that reflects the age classes and structural diversity of unmanaged stands of the similar community type. Riparian Conservation Areas (RCAs) trend toward the natural range of variability appropriate for the site and local conditions.

Objective AQ-13. Maintain ground covering litter, duff, and/or vegetation on at least 90% of non-rocky riparian areas.

General

Objective AQ-14. All Forest Service projects and decisions meet state and federal water quality requirements, including the Porter-Cologne Water Quality Control Act (PCA), water quality control regulations, plans, policies, and program plans approved by the State Water Resources Control Board (SWRCB) pursuant to the foregoing federal and state statutes.

Objective AQ-15. Applicable Best Management Practices (BMPs) are fully implemented and monitored for their effectiveness. The monitoring system is transparent, informs the State Water Board and the public of failures, and is effective in applying adaptive management to improve future projects.

Objective AQ-16. Degraded or impaired water bodies are identified and prioritized for the remediation and a schedule adopted for remediation.

Objective AQ-17. Maintain resiliency through redundancy of key habitat types (e.g. lakes, streams, rivers, fens, wet meadows) and features (e.g. riffles, pools, emergent vegetation), and maintenance of ecosystem services, refugia, and connectivity.

Objective AQ-18. Restore or improve the ecological balance and connectivity within and across habitats that are negatively affected by non-indigenous invasive or problem species

Objective AQ-19. All Forest Service projects and decisions improve or maintain and do not degrade aquatic ecosystems.

Objective AQ-20. Spread of diseases and non-native species through direct or indirect anthropogenic vectors is eliminated.

Objective AQ-21. Management activities focus on the restoration of landscape dynamics (e.g. connectivity, heterogeneity, succession, disturbance) and associated processes (e.g. fire regime, flood regime) to promote long-term ecosystem sustainability and resilience, while minimizing mechanical alterations to habitat and other highly invasive and resource intensive approaches to landscape management, except those of an emergency, short term nature necessary to reestablish landscape functionality.

Objective AQ-22. Identify and implement restoration actions to maintain, restore or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.

Riparian Conservation Objectives

The general objectives above for the aquatic ecosystem apply in the RCAs and ADEs. In addition, the following objectives are applicable to RCAs and more generally applied in the ADE land allocation.

Objective AQ-23. Ensure an adequate, renewable supply of large down wood, while recognizing and accommodating natural variation in time and space due to fire, floods, disease, and other natural disturbances. Large wood must be able to reach the stream channel and provide suitable habitat within and adjacent to the RCA. Natural recruitment processes for large wood remain functional and large wood is not removed as a result of management in RCAs, excepting that which is consumed by wildfire or prescribed fire.

Objective AQ-24. Maintain or restore: 1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, and springs; 2) streams, including in stream flows; and 3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.

Objective AQ-25. Ensure that management activities, including fuels reduction actions, within RCAs and ADEs enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.

Objective AQ-26. Meadows, streams and other aquatic features are hydrologically functional. Projects are designed to stabilize and recover sites from accelerated erosion. Such sites, e.g., gullies and headcuts, are identified and projects implemented to stabilized or recover them.

Objective AQ-27. Road reduction and remediation is a high priority for action in ADEs.

C. Standards

The following standards were adapted from USDA Forest Service and USDI Fish and Wildlife Service (1995), USDA Forest Service (2008) and recommendations in Scurlock and Frissell (2012).

General Management in Riparian Conservation Areas (RCAs)

Standard AQ-1. Project activities in RCAs:

- When RCAs are properly functioning,[6] project activities should maintain those conditions.
- When RCAs are not properly functioning, and to the degree that project activities would drive or contribute to improper function, project activities should improve those conditions.
- Project activities in RCAs should not result in long-term degradation to aquatic and riparian conditions at the watershed scale. Limited short term or site-scale effects from activities in RCAs may be acceptable when they support, or do not diminish, long-term benefits to aquatic and riparian resources.

Standard AQ-2. Apply herbicides, insecticides, pesticides and other toxicants, and other chemicals only when long-term effectiveness can be clearly demonstrated, to maintain, protect, or enhance aquatic and riparian function and composition.

Standard AQ-3. Trees that are felled within RCAs should be retained onsite to maintain, protect, or enhance aquatic and riparian resources.

Standard AQ-4. Locate water drafting in sites that present the least harm to aquatic and riparian resources and manage sites to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Standard AQ-5. Pumps shall be screened at drafting sites to prevent entrainment of fish and shall have one-way valves to prevent back-flow into streams.

Vegetation Management

Standard AQ-6 Timber harvest and thinning should occur in RCAs only as necessary to maintain, restore or enhance conditions that are needed to support aquatic and riparian dependent resources.

Standard AQ-7. Fuelwood cutting shall not be authorized in the active floodplain or within primary source areas for large woody debris. Active floodplain is the area bordering a stream that is inundated by flows at a surface elevation defined by two-times the maximum bankfull depth (i.e., bankfull depth measured at thalweg).

[6] Assessment of properly functioning or fully functioning condition is a concept originally developed by the BLM to assess the natural habitat forming processes of riparian and wetland areas (Pritchard et al. 1994). Ecosystems at any temporal or spatial scale are in a properly functioning condition when they are dynamic and resilient to perturbations to structure, composition and processes of their biological and physical components (USDA Forest Service 1998). Primary elements typically include hydrologic characteristics, physical structure/form, vegetative characteristics, water quality and aquatic/riparian biological community characteristics. The general methodology provides an integrated measure of condition and can be used at a variety of scales from individual reaches to watersheds. The basic approach is used to assess a wide range of process-based, riparian and aquatic conditions. The current process in Region 6 is to assess watershed condition, which uses the Ecosystem Management Decision Support (EMDS) model used at the sub-watershed and watershed scales. This general methodology has also been used for salmonid systems by the NMFS (1996) and as a tool in salmon conservation and recovery planning (e.g., Ecosystem Diagnosis and Treatment Model (EDT) described by Lestelle et al. 2004).

Standard AQ-8. The salvage of dead or dying trees following wildfire is limited to activity necessary to address safety concerns.

Standard AQ-9. Avoid locating new landings, designated skid trails, staging or decking in RCAs. If no alternatives exist and the management activities are necessary to maintain, restore or enhance conditions that support aquatic and riparian dependent resources, design these features to:

- Be of minimum size;
- Be located outside the active floodplain; and
- Minimize effects to large wood, bank integrity, temperature, and sediment levels.

Road Management

Standard AQ-10. Avoid new road construction in RCAs except where necessary for stream crossings.

Standard AQ-11. Avoid side-casting (placement of unconsolidated earthen waste materials resulting from road construction or maintenance) in RCAs.

Standard AQ-12. Avoid placing fill material on organic debris in RCAs.

Standard AQ-13. Minimize or avoid disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow when constructing or reconstructing any roads or landings.

Standard AQ-14. Avoid wetlands and unstable areas when reconstructing existing roads or constructing new roads and landings.

Standard AQ-15. New or replaced permanent stream crossings shall accommodate at least the 100-year flood, including associated bedload and debris.

Standard AQ-16. Construction or reconstruction of stream crossings should avoid diversion of streamflow out of the channel and down the road in the event of crossing failure.

Standard AQ-17. In fish bearing streams, construction or reconstruction of stream crossings will provide and maintain passage for all fish species and all life stages of fish.

Standard AQ-18. Construction or reconstruction of stream crossings should allow passage for other riparian dependent species.

Standard AQ-19. Fish passage barriers should be retained where they serve to restrict access by undesirable non-native species and are consistent with restoration of habitat for native species.

Standard AQ-20. Minimize hydrologic connectivity of the road system and delivery of sediment from roads to watercourses. This includes roads inside and outside of RCAs.

Standard AQ-21. Road drainage should be routed away from potentially unstable channels, fills, and hillslopes. This applies both inside and outside of RCAs.

Standard AQ-22. Protect fish habitat and water quality when withdrawing water for administrative purposes.

Grazing Management

Standard AQ-23. Avoid locating livestock handling, management or watering facilities in RCAs.

Standard AQ-24. Prohibit livestock trailing, bedding, loading, and other handling activities in RCAs.

Standard AQ-25. Permit livestock and packstock use of RCAs and ADEs where aquatic and riparian resources are maintained, protected, or enhanced and where allowing such activities does not retard or prevent attainment of aquatic conservation objectives.

Standard AQ-26. Suspend grazing in RCAs that contain perennial saturated meadows with non-cohesive soils which only contain shrubs, grasses, and forbs. Prevent grazing in seeps, springs, fens, and other unique wetted areas.

Standard AQ-27. Eliminate livestock access to spawning reaches of streams during the spawning and incubation period.

Standard AQ-28. Permit grazing only where livestock can be prevented, through fencing or other means, from entering riparian and wet meadow areas that are off limits to grazing.

Standard AQ-29. Mineral extraction, including hard-rock mining and suction dredging, in RCAs shall be permitted in situations where such activities do not impede the attainment of aquatic and riparian conservation objectives, as determine through landscape analysis. In situations where the conservation objectives have been met or are exceeded, the effects of mineral extraction shall not contribute to a decline in the existing condition.

Standard AQ-30. Develop ecological objectives for aquatic and riparian habitats affected by livestock and packstock management during landscape analysis or allotment planning. Until such standards limit grazing and packstock use to:

- 40% utilization for upland areas in good condition;
- 20% utilization for upland areas in poor condition;
- 5-inches stubble height for meadows and riparian areas in good condition;
- 7-inches stubble height for meadows and riparian areas in poor condition;
- 5% maximum annual utilization on new growth on riparian browse species and oaks;
- 15% maximum annual utilization on new growth on highly palatable upland browse species; and
- 5% limit on streambank alteration.

Standard AQ-31. On each national forest establish a minimum of six water quality monitoring stations for *E. coli* and other potential pathogens impacting public health and safety in high use recreation areas and meadows where high levels of grazing currently occur and spot monitoring of streamcourses witin all allotments.

Standard AQ-32. Restrict grazing in monitored areas where level of *E. coli* or others pathogens persist after 2 years of mitigation failure where there is a risk to public health as determined by basin plans.

Recreation Management

Standard AQ-33. Avoid placing new facilities or infrastructure within expected long term channel migration zone. Where activities inherently must occur in RCAs, e.g., road stream crossings, boat ramps, docks, interpretive trails, locate them to minimize impacts on riparian dependent resources (e.g., within geologically stable areas, avoiding major spawning sites).

Standard AQ-34. Remove or relocate existing recreation facilities that are in conflict with maintaining, protecting, or enhancing aquatic and riparian resources.

Standard AQ-35. Remove or relocate all existing OHV routes within meadow systems during the first decade of implementation of the new forest plan.

Minerals Management

Standard AQ-36. Avoid adverse effects to aquatic and other riparian dependant resources from mineral operations and do not allow activities that retard or prevent attainment of aquatic conservation objectives in the short or long term.

Standard AQ-37. Locate structures and support facilities for mining outside RCAs.

Standard AQ-38. Locate mine waste outside of RCAs.

Standard AQ-39. Do not issue new permits for suction dredge operations on National Forest Lands.

Fire Management

Standard AQ-40. Temporary fire facilities (e.g., incident bases, camps, wheelbases, staging areas, helispots and other centers) for incident activities should be located outside RCAs. When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian dependent resources should be used.

Standard AQ-41. Aerial application of chemical retardant, foam, or other fire chemicals and petroleum should be avoided within 300 feet of waterways.

Standard AQ-42. Water drafting sites for emergency response should be located and managed to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Standard AQ-43. Pumps for emergency response shall be screened at drafting sites to prevent entrainment of native and desired non-native fish and shall have one-way valves to prevent back-flow into streams.

Standard AQ-44. Portable pump set-ups for emergency response shall include containment provisions for fuel spills and fuel containers shall have appropriate containment provisions. Vehicles shall be parked in locations that avoid entry of spilled fuel into streams.

Standard AQ-45. Generally locate and configure fire lines to minimize sediment delivery, creation of new stream channels and unauthorized roads and trails.

Standard AQ-46. Use Minimum Impact Suppression Tactics (MIST) during fire suppression activities in RCAs (NWCG 2006).

Lands and Special Uses, including Hydropower

Standard AQ-47. Authorizations for all new and existing special uses including, but not limited to water diversion or transmission facilities (e.g., pipelines, ditches), energy transmission lines, roads, hydroelectric and other surface water development proposals, shall result in the re-establishment, restoration, or mitigation of habitat conditions and ecological processes identified as being essential for the maintenance or improvement of habitat conditions for fish, water and other riparian dependent species and resources. These processes include in-stream flow regimes, physical and biological connectivity, water quality, and integrity and complexity of riparian and aquatic habitat.

Standard AQ-48. Locate new support facilities outside of RCAs. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas, transmission lines) not directly integral to the production of hydroelectric power or necessary for the implementation of prescribed protection, mitigation or enhancement measures.

Standard AQ-49. If existing support facilities are located within the RCAs, they should be operated and maintained to restore or enhance aquatic and riparian dependent resources. At time of permit reissuance, consider removing support facilities, where practical.

Aquatic Diversity Emphasis (ADE)

Standard AQ-50. Allow no net increase in the mileage of roads in any ADE unless doing so results in a reduction in road-related impact and risk to watershed condition. The term “no net increase” means that for each mile of new road constructed at least one mile of road must be decommissioned to a hydrologically stable and self-maintaining condition. The decommissioning must occur at the same time or before the road construction. Priority for decommissioning should be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems.

Standard AQ-51. Hydroelectric and other water development authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian dependent resources, favorable channel conditions, and aquatic connectivity.

Standard AQ-52. New hydroelectric facilities and water developments shall not be located in an ADEs unless it can be demonstrated they have minimal risks and/or no adverse effects to fish and water resources for which the key watershed was established.

Restoration

Standard AQ-53. Design and implement watershed restoration projects in a manner that promotes the long-term integrity of ecosystems, conserves the genetic integrity of native species, and contributes to attainment of desired conditions and achieve objectives.

Standard AQ-54. Cooperate with Federal, State, local, and Tribal agencies, and private landowners to develop watershed-based Coordinated Resource Management Plans (CRMPs) or other cooperative agreements to meet desired conditions and achieve objectives.

Standard AQ-55. Do not use planned restoration as a substitute for preventing habitat degradation (i.e., use planned restoration only to mitigate existing problems, not to mitigate the effects of proposed activities with restoration activities).

Standard AQ-56. Apply appropriate erosion control measures to landings, skid trails and other sediment source areas. Obliterate or decommission source areas on sensitive landforms such as RCAs and steep slopes. Emphasize use of prescriptions that require little to no maintenance. Where revegetation is used, use native species (or non-native species that are not persistent). Priorities areas for such activities are areas:

- Within RCAs;
- That drain to and exacerbate road drainage and erosion problems;
- In subwatersheds that drain directly to anadromous holding and spawning habitat; and
- In rhyolitic soils.

Special Habitats

Standard AQ-57. Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (*Spagnum spp*.), (2) mosses belonging to the genus *Meessia*, and (3) sundew (*Drosera spp*.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits (USDA Forest Service 2004).

Standards and Conservation Measures for Species Associated with Aquatic and Riparian Habitats

Species-specific standards and conservation measures are presented in Appendix A for the species listed in Table IV D-1.

Table IV D-1. Species associated with riparian or aquatic habitats for which standards and conservation measures have been included in Appendix A.

Scientific Name	Common Name	Reason for Inclusion
Strix nebulosa	Great gray owl	Species at risk
Rana sierrae	Sierra Nevada yellow-legged frog	Species at risk
Bufo canorus	Yosemite toad	Species at risk
Oncorhychus mykiss aguabonita	California golden trout	Species at risk
Oncorhychus mykiss aquilarum	Eagle Lake rainbow trout	Species at risk
Oncorhychus mykiss subsp	Goose Lake redband trout	Species at risk
Mylopharodon conocephalus	Hardhead	Species at risk
Lampetra hubbsi	Kern brook lamprey	Species at risk
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	Species at risk
Catostomus platyrhynchus	Mountain sucker	Species at risk
Rinichthys osculus. subsp	Owens speckled dace.	Species at risk

D. Land Allocations

Table IV D-2. Land allocations primarily focused on aquatic ecosystems.

Land Allocation	Definition	Management Objective
Riparian Conservation Area (RCA)	Defined by stream type and condition Ranges from 150 feet to 300 feet from the midpoint of the stream. The RCA widths below may be adjusted at the project level if a landscape analysis has been completed and a site-specific assessment of the riparian conservation objectives (RCOs) demonstrates a need for different widths. Perennial Streams: 300 feet on each side of the stream, measured from the bank full edge of the stream. Seasonally Flowing Streams (includes intermittent and ephemeral streams): 150 feet on each side of the stream, measured from the bank full edge of the stream Streams in Inner Gorge: top of inner gorge (Inner gorge is defined by stream adjacent slopes greater than 70 percent gradient) Special Aquatic Features or Perennial Streams with Riparian Conditions extending more than 150 feet from edge of streambank or Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of streambank: 300 feet from edge of feature or riparian vegetation, whichever width is greater. Special Aquatic Features include: lakes, wet	Restore ecological process where doing so does not threaten critical values. Maintain, restore, enhance, and protect. Limited levels of ground and vegetation disturbance allowed. Avoid actions that retard or prevent attainment of aquatic conservation objectives.

Land Allocation	Definition	Management Objective
	greater. Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs. Other hydrological or topographic depressions without a defined channel: RCA width and protection measures determined through project level analysis. Inner gorge is defined by stream adjacent slopes greater than 70 percent gradient. Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs.	
Aquatic Diversity Emphasis (ADE)	Watershed in which protecting or maintaining aquatic diversity is the priority.	Restore ecological process where doing so does not threaten critical values. Avoid actions that retard or prevent attainment of aquatic conservation objectives.
Yosemite Toad (YT)	Habitat around sites with YT including wet meadows with standing water and saturated soils, streams, springs, important upland habitat, and habitat identified as "essential habitat" in the conservation assessment for the Yosemite toad.	Provide habitat conditions to support successful reproduction and persistence. Maintain hydrologic function of meadow system. Limit human uses in areas not currently in excellent condition.
Willow Flycatcher: Occupied and Emphasis (WF)	**Occupied habitats** are meadows or riparian sites with documented willow flycatcher. **Emphasis habitat** are defined as meadows larger than 15 acres that have standing water on June 1 and a deciduous shrub component.	Provide habitat conditions to support successful reproduction and persistence. Limit human uses in areas not currently in excellent condition. Maintain hydrologic function of meadow system.
Great gray owl Protected Activity Center (PAC)	Designation around known nesting sites for great gray owl (50-200 acres). Inclusion in PAC of area within 300 feet of structures is avoided.	Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Encourage citizen watershed monitoring groups to collaborate with the Forest Service to establish ongoing water quality and trend and condition monitoring for riparian and aquatic resources on each national forest.

Recommendations for New Regional Direction or Policy

- Establish and implement scientifically proven methodologies that include monitoring and evaluation mechanisms to guide protection and restoration of aquatic ecosystems.

- As a means to more effectively adapt to climate change, ensure that principles of ecological resiliency guide protection and restoration of aquatic and adjacent ecosystems. It is essential to address the need for resilience associated with aquatic ecosystems through the provision of refugia, maintenance of critical habitats, and the functional connectivity between various habitats supporting aquatic species.

- Provide direction on aquatic conservation planning based on sound science, rigorous research, open and inclusive planning processes, collaborative monitoring, and input from a broad and diverse group of stakeholders.

- Provide guidance to national forest on how to manage aquatic ecosystems across relevant scales, including guidance on how to integrate planning at the reach-level with the larger watershed scale.

- Secure consistent and adequate institutional financial and technical support to support proper management of aquatic systems.

- Provide regional assessments and conservation strategies for use in forest planning that are based on sound science, rigorous research, ongoing resource monitoring, open and inclusive planning processes, and input from a broad and diverse group of stakeholders.

Additional Recommendations

- Cooperate with Federal, Tribal, State and local governments to secure in-stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in- stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.

- California Department of Fish and Game should be allocated the resources to monitor and enforce the distribution of sensitive fish and other aquatic species populations and to engage effectively in water-rights decision processes, water diversion issues, land-management planning and conservation planning actions to restore and enhance aquatic systems (California Department of Fish and Game 2007).

- Promote the involvement of California Department of Fish and Game during the FERC relicensing process to pursue changes in operations of hydropower projects that will provide more water for wildlife, mandate that water flows be managed as close to natural flow regimes as possible, and ensure that the new license agreements provide the best possible conditions for ecosystems and wildlife (California Department of Fish and Game 2007).

- During relicensing of FERC hydroelectric projects, evaluate modifications to the natural hydrograph caused by the project. Determine and recommend in stream flow requirements and habitat conditions that maintain, enhance, or restore all life stages of native aquatic species, and that maintain or restore riparian resources, channel integrity, and fish passage. Provide written and timely license conditions to FERC. Coordinate relicensing projects with the appropriate State and Federal agencies.

- Promote to the California Department of Fish and Game the establishment of trout-free sub-basins and lakes across the high Sierra and Cascades to restore amphibians and other native species while concurrently improving trout fisheries in other lakes (California Department of Fish and Game 2007).

Table IV.D-3. Conservation status of forest-dwelling aquatic and riparian-dependent species of special concern on national forests in the Sierra Nevada (updated from USDA Forest Service 2001, Appendix R, Tables R.3, R.4, R.5) (Scurlock and Frissell 2012, Appendix A).

Common Name ***Latin name***	**National Forest Occurrence** (if known)	**Conservation Status**
Bigeye marbled sculpin *Cottus klamathensis macrops*	Lassen, Shasta-Trinity, Modoc?	CA Species of Special Concern AFS Vulnerable
Black toad *Anaxyrus exsul*	Not known to occur on national forest lands (USDA Forest Service 2000).	CA Threatened CA Fully Protected
Blue chub *Gila coerulea*		CA Species of Special Concern
Breckenridge Mt. Slender salamander *Batrachoseps spp.*	Sequoia (but “possibly extinct”) (USDA Forest Service 2000).	CA Species of Special Concern FS Sensitive Species
Bull trout, *Salvelinus confluentus*	Shasta-Trinity (Extinct)	Considered extinct CA Endangered Species
California red-legged frog, *Rana aurora draytonii*	Plumas (Butte County), near Eldorado, maybe on Tahoe (USDA Forest Service 2000)	Federal ESA threatened CA Species of Special Concern
California tiger salamander *Ambystoma californiense*	Lassen, Plumas, Sierra, Sequoia within range, but no FS records of presence. (USDA Forest Service 2000)	Federal ESA Threatened Species CA Threatened Species CA Species of Special Concern
Cascade Frog *Rana cascadae*	Lassen, Modoc	CA Species of Special Concern FS Sensitive Species
Central Valley fall run Chinook salmon *Oncorhynchus tshawytscha*	Lassen	CA Species of Special Concern NMFS Species of Concern FS Sensitive Species AFS Vulnerable
Central Valley late fall run Chinook salmon *Oncorhynchus tshawytscha*	Lassen	CA Species of Special Concern NMFS Species of Concern FS Sensitive Species AFS Vulnerable
Central Valley spring run Chinook salmon, *Oncorhynchus tshawytscha*	Lassen	Federal ESA Threatened CA Threatened AFS Threatened
Central Valley winter run Chinook salmon, *Oncorhynchus tshawytscha*	Lassen	CA Threatened
Central Valley winter steelhead *Oncorhynchus mykiss irideus*	Lassen	Federal ESA threatened AFS Threatened Species
Cowhead Lake tui chub *Siphateles bicolor vaccaceps*	Modoc vicinity, but found outside areas of national forest influence	CA Species of Special Concern AFS Endangered
Eagle Lake rainbow trout *Oncorhynchus mykiss aquilarum*	Lassen	CA Species of Special Concern FS Sensitive Species AFS Threatened
Eagle Lake tui chub *Siphateles bicolor*	Lassen	CA Species of Special Concern

Common Name *Latin name*	**National Forest Occurrence** (if known)	**Conservation Status**
Foothill Yellow-Legged Frog *Rana boylii*	Eldorado, Lassen, Plumas, Sequoia, Sierra, Stanislaus, Tahoe	CA Species of Special Concern FS Sensitive Species BLM Sensitive species
Goose Lake lamprey *Lampetra tridentate ssp.*	Modoc	CA Species of Special Concern AFS Vulnerable
Goose Lake redband trout *Oncrohynchus mykiss ssp.*	Modoc	CA Species of Special Concern FS Sensitive Species AFS Vulnerable
Goose Lake sucker *Castomus occidentalis lacusanerinus*	Modoc	CA Species of Special Concern FS Sensitive AFS Vulnerable
Goose lake tui chub *Gila bicolor thalassina*	Modoc	CA Species of Special Concern FS Sensitive AFS Threatened
Hardhead *Mylopharodon conocephalus*	All	CA Species of Special Concern FS Sensitive Species
High Rock Spring tui chub, *Gila bicolor ssp.*	Plumas NF is contributing area to Honey Lake Basin http://www.dfg.ca.gov/habcon/info/fish_ssc.pdf,]	Considered extinct CA Species of Special Concern
Inyo Mountains Salamander *Batrachoseps campi*	Inyo, Sequoia (?)	CA Species of Special Concern BLM Sensitive Species FS Sensitive Species
Kern brook lamprey *Lampetra hubbsi*	Sierra, Sequoia, Stanislaus, Eldorado	CA Species of Special Concern AFS Threatened
Kern Canyon Slender Salamander *Batrachoseps simatus*	Sequoia	CA Threatened Species FS Sensitive Species
Kern Plateau Salamander *Batrachoseps robusts*	Inyo, Sequoia	FS Sensitive Species
Kern River rainbow trout *Oncorhynchus mykiss gilberti*	Sequioa	CA Species of Special Concern AFS Threatened
Klamath largescale sucker *Castomus snyderi*	Modoc (partial contributing area, Lost R.)	CA Species of Special Concern AFS Threatened
Lahontan cutthroat trout *Oncorhynchus clarki henshawi*	Tahoe	Federal ESA Threatened AFS Threatened
Lahontan Lake tui chu *Gila bicolor pectinifer*	Tahoe, Lake Tahoe Basin	CA Species of Special Concern FS Sensitive
Limestone salamander *Hydromantes brunus*	Sierra, Stanislaus	CA Threatened Species CA Fully Protected Species FS Sensitive Species
Little Kern golden trout *Oncorhyncus mykiss whitei*	Sequioa	Federal Threatened AFS Endangered
Lost River Sucker *Deltistes luxatus*	Modoc (partial contributing area, Lost R.)	Federal Endangered CA Endangered CA Fully Protected AFS Endangered
McCloud River redband trout	Shasta-Trinity	CA Species of Special Concern FS Sensitive Species AFS Vulnerable

Common Name *Latin name*	**National Forest Occurrence** (if known)	**Conservation Status**
Modoc sucker *Castomus microps*	Modoc	Federal ESA Endangered CA Endangered CA Fully Protected AFS Endangered
Mount Lyell Salamander *Hydromantes platycephalus*	Potentially on 8 national forests (SNFPA DEIS 2000)	CA Species of Special Concern
Mountain sucker *Castomus platyrhynchus*	All	CA Species of Special Concern
Mountain whitefish *Prosopium williamsoni*	Tahoe, Eldorado	“near threatened” (Moyle 2011)
Mountain Yellow-legged Frog complex *Rana sierrae and R. muscosa*	Eldorado, Inyo, Lassen, Plumas, Sequoia, Sierra, Stanislaus, Tahoe, Lake Tahoe Basin (4500-12,000 feet elevation).	Warranted, Federal ESA Endangered CA Endangered -Candidate CA Species of Special Concern FS Sensitive Species
Northern Leopard Frog *Lithobates pipiens*	Eldorado, Inyo, Modoc, Plumas, Lake Tahoe Basin	CA Species of Special Concern FS Sensitive Species
Owens pupfish *Cyprinodon radiosus*	Inyo	Federal ESA Endangered CA Endangered California Fully Protected AFS Endangered
Owens speckled dace *Rhinichthys osculus ssp.*	Inyo	CA Species of Special Concern AFS Threatened
Owens sucker *Castomus fumeiventris*	Inyo	CA Species of Special Concern
Yosemite toad *Bufo canorus*	Stanislaus, Sierra	FC, FSS, CSSC

A list of the sources for conservation status for species noted in Table IV.D-3.

Federal ESA threatened, endangered or candidate (original decision or most recent status review)

California red-legged frog, *Rana aurora draytonii*: 61 Fed. Reg. 25813 (May 23, 1996)
California tiger salamander, *Ambystoma californiense*: 69 Fed. Reg. 47212 (Aug. 4, 2004)
Central Valley spring run Chinook salmon, *Oncorhynchus tshawytscha*: 64 Fed. Reg. 50394 (Sept. 16, 1999), 70 Fed. Reg. 37160 (June 28, 2005)
Central Valley winter steelhead, *Oncorhynchus mykiss irideusi*: 63 Fed. Reg.13347(March 19, 1998), 76 Fed. Reg. 50447 (Aug. 15, 2011).
Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*: 35 Fed. Reg. 13519 (Aug. 25, 1970), 40 Fed. Reg. 29863 (July 16, 1975), 75 Fed. Reg. 28636 (May 21, 2010)
Lost River sucker, *Deltistes luxatus*: 53 Fed. Reg. 27130 (July 18, 1988), 73 Fed. Reg. 11945 (March 5, 2008)
Modoc sucker, *Castomus microps*: 50 Fed. Reg. 24526 (June 11, 1985), 75 Fed. Reg. 28636 (May 21, 2010).
Mountain yellow-legged Frog, *Rana muscosa*: 72 Fed. Reg. 34657 (June 25, 2007), 76 Fed. Reg. 66370 (Oct. 26, 2011)
Owens pupfish, *Cyprinodon radiosus*: 32 Fed. Reg. 4001 (March 11, 1967), 75 Fed. Reg. 28636 (May 21, 2010).

Owens tui chub, *Gila bicolor snyderi:* 50 Fed. Reg. 31592 (Aug. 5, 1985), 75 Fed. Reg. 28636 (May 21, 2010).
Paiute cutthroat trout, *Oncorhynchus clarki seleniris*: 32 Fed. Reg. 4001 (March 11, 1967), 74 Fed. Reg. 12878 (March 25, 2009)
Shortnose sucker, *Chamistes brevirostris*: 53 Fed. Reg. 27130 (July 18, 1988), 73 Fed. Reg. 11945 (March 5, 2008)
Spotted frog, *Rana pretiosa*: 58 Fed. Reg. 27260 (May 7, 1993), 76 Fed. Reg. 66370 (Oct. 26, 2011)
Yosemite toad, *Bufo canorus*: 67 Fed Reg. 75834 (Dec. 10, 2002), 76 Fed. Reg. 66370 (Oct. 26, 2011).

California Endangered Species: threatened or endangered

Cal. Code. Regs. Title 14, §670.5 available at http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome; http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf

California Fully Protected Species

Cal Fish & Game Code §5050 available at http://leginfo.legislature.ca.gov/faces/codes.xhtml
Cal Fish & Game Code §5515 available at http://leginfo.legislature.ca.gov/faces/codes.xhtml
Cal. Code. Regs. Title 14, §5.93 available at http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome

California Species of Special Concern:

Moyle et al. (1995)
Jennings and Hayes (1994)

Forest Sensitive Species (defined in FSM 2670.5)

USDA Forest Service (2007)

BLM sensitive species

BLM Manual §6840, available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/im_attachments/2009.Par.13736.File.dat/IM2009-039_att1.pdf
http://www.blm.gov/ca/pdfs/pa_pdfs/biology_pdfs/SensitiveAnimals.pdf

NMFS Species of Concern

http://www.nmfs.noaa.gov/pr/species/concern

AFS status (vulnerable, threatened endangered)

Jelks et al. (2008)

"near threatened"

Moyle et al. (2011)

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CONSERVATION OF SPECIES AT RISK

ISSUE STATEMENT

The Sierra Nevada is home to a wide variety of plants and wildlife, many of which are special status species (see Appendix B for a listing of special status species in the Sierra Nevada). There are 572 vertebrate species that inhabit the Sierra Nevada and Cascades region during some portion of their life cycles, including 61 fish species, 37 amphibians, 46 reptiles, 293 birds, and 135 mammals (California's Wildlife 2007). Eighty-eight plant communities and more than 3,500 plant species occur within this region (CWWR 1996). The California Floristic Province, which includes the Sierra Nevada, has been cited as a hotspot of biodiversity and important to the conservation of global biodiversity (Mittermeier et al. 1998). This diversity of flora and fauna reflects the diverse habitat types found in the Sierra, such as old growth forests, montane meadows, sagebrush scrub, mixed-conifer/hardwood forests, and riparian corridors.

Several major stressors have altered Sierran ecosystems from historical conditions, such as forest management activities including timber harvest, habitat fragmentation, excessive livestock grazing, aggressive fire suppression, human population growth and land development, illegal off-road vehicle use, disease, invasive species, and climate change.

A recent study that modeled climate change and its effects on California's flora determined that two-thirds of our state's endemic plant species will suffer an 80 percent reduction in geographic range by the end of the 21st century, and that the Sierra Nevada range would be particularly hard hit (Loarie et al. 2008). It is not likely that many plant species will be able to adapt in time to avoid extinction, given the tremendous reductions in suitable habitat and regeneration rates of rare species today. The study underscores the urgency to preserve and protect rare species and their habitats, use managed fire when appropriate and where species can benefit, and replenish now depleted seed banks. Other climate change related threats include loss of habitat from increases in uncharacteristic fire and invasive species expansion.

The Forest Service has affirmed the relationship between native plant diversity and the viability of associated species. For example, in *Every Species Counts: Conserving Biological Diversity*, the agency acknowledges that "[t]he extinction of even a single plant species may result in the disappearance of up to 30 other species of plants and wildlife" (USDA Forest Service, 1993).

Wildlife faces harm from a broad range of threats that often include impacts on private lands that are intermixed with or adjacent to national forest lands of the region. With national forest land managers only able to control what occurs on federal lands, Forest Plan revisions must set the highest standards for ensuring persistence and recovery of special status species.

Past and current logging practices and altered fire regimes have greatly changed the developmental patterns of vegetation to the detriment of associated species and ecosystem functions (Franklin and Fites 1996, McKelvey et al. 1996). Habitat fragmentation is a major threat. Fragmented habitats are more vulnerable to many forms of ecological stress including fire and drought, which are more severe on forest edges (Laurance and Cochrane 2001). Degradation of mountain meadows and riparian vegetation has negatively impacted species that require such habitats. Introduction of non-native trout has caused declines in native aquatic species (California's Wildlife 2007).

In the past, a lack of landscape level planning of timber harvests led to an alarming loss of old forests on national forest lands (Ecological Society of America 2000). The Forest Service has come a long way since then. Indeed, the Pacific Northwest Region recently completed multi-scale species assessments in support of their forest plan revisions. These assessments were based on the principles of science and integrated information on habitat use and vegetation to create new tools to aid species management. For species such as the American marten, which are sensitive to habitat loss and fragmentation, habitat connectivity was analyzed at the state, national forest and watershed scales. This science-based analysis will help national forests in Oregon address species habitat needs and risk factors in order to sustain populations. The Forest Service should engage scientists and other experts to create science-based assessments and tools to support the forest planning process and viable wildlife populations in the Sierra Nevada. An example of such an approach is the recent agreement among the Forest Service and conservation groups to undertake an independent peer-review of recently adopted management indicator species and monitoring plan.

Current management for most forest carnivores and raptors is inconsistent between national forests in the Sierra Nevada. Sufficient information on habitat use by forest carnivores and raptors exists to identify a management strategy designed to conserve and restore these species. The targeted forest carnivores are generally wide- ranging species that are dependent on late successional forest ecosystems for habitat (Verner et al. 1992, Graber 1996). Because of their mobility and requirement for unfragmented habitat, an integrated, rangewide strategy is needed to address their habitat needs. A managed reserve system that is linked by suitable dispersal habitat could be designed to meet the needs of forest carnivores and conserve and restore late successional old growth forests. Such a managed reserve would also contribute to the habitat needs of raptors, such as the California spotted owl, northern goshawk and great gray owl, by providing suitable foraging and/or nesting habitat.

California's comprehensive wildlife conservation strategy, *California Wildlife: Conservation Challenges*, recommends that federal agencies partner with the state and work with local governments to secure sensitive habitats and key habitat linkages (Wildlife Health Center, U.C. Davis 2007). This would include an inventory and evaluation of sensitive wildlife habitat and linkage areas, incorporation of habitat linkages and other identified key habitats into conservation plans, and adaptive management provisions to protect important wildlife linkages as they are identified; and creating partnerships with state and local land managers to prioritize and secure linkages and other priority habitats that are not currently protected. Furthermore, the state wildlife action plan recommends that federal, state and local agencies, along with nongovernmental organizations, support scientific studies to identify key wildlife habitat linkages throughout the state in an effort to address habitat fragmentation and avoid the loss of key wildlife corridors. The South Coast Missing Linkages Project[1] has identified key wildlife corridors in South Coast Region. A similar effort is needed in each region of the state, including the Sierra Nevada.

An ecosystem-based landscape conservation strategy should be a regional level responsibility to ensure scientifically credible designs are applied across jurisdictions rather than forest-by-forest strategies. As part of this effort, the agency should work to maintain wildlife viability across a larger biogeographical region by maintaining and restoring landscape connectivity and protecting core habitat. This must include requirements for monitoring of the status and trends in the conditions or characteristics of ecosystem diversity, including the conditions that support focal species and species of concern, as well as monitoring of the populations of focal species and species of concern. Monitoring of habitat cannot stand alone, but must be validated with actual population data in order to ensure that the Forest Service is achieving its species diversity and viability goals.

The Sierra Nevada provides a tremendous opportunity for the Forest Service to adopt a robust ecosystem-based, landscape level conservation strategy. National forests represent the majority of

[1] *See* http://www.scwildlands.org/projects/scml.aspx

land in the Sierra Nevada. These forests must be managed with the goal of protecting rare plant and wildlife diversity and viability, as well as species' ability to adapt to changing environmental conditions. Land managers are responsible for sustaining native biodiversity and are obligated not to put any species at risk of extinction (Noon et al. 2009). In other words, they must manage in a way that benefits and sustains multiple species. This includes ensuring viability of special status species while keeping common species common. The Forest Service must act to reduce stressors that negatively affect plants and wildlife at multiple scales, identify species at risk, adopt specific conservation measures and fully implement recovery plan recommendations. If pursued diligently and executed properly, declining trends for species at risk will be reversed and viable wildlife and rare plant populations will flourish throughout the national forests of the Sierra Nevada.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition. *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition SAR-1. The distribution and abundance of native species and habitats is influenced by naturally occurring biophysical disturbances and changes in the ecosystem.

Desired Condition SAR-2. Human caused disturbances do not occur at a scale and frequency that adversely affects the viability of native species or the overall persistence and quality of habitats in the planning area.

Desired Condition SAR-3. Aquatic-riparian habitats and montane meadows have a high ecological function, include key structural attributes and support the expected aquatic-riparian dependent species.

Desired Condition SAR-4. High quality home ranges and dispersal habitat for forest carnivores, such as fisher, American marten, Sierra Nevada red fox, and wolverine, are distributed across the landscape in a pattern that allows the movement of these species and thereby facilitates breeding among individuals.

Desired Condition SAR-5. High quality habitat for raptors, such as California spotted owl and northern goshawk supports their preferred prey species as well as mature forests to support productive nest sites. Habitat of the California spotted owl continues to be linked with that of the northern spotted owl on the Lassen and Modoc national forests. Each of these species is well distributed throughout its historical range.

Desired Condition SAR-6. Species invasions, promoted through simplification and homogenization of forest habitats, are slowed and minimized through habitat improvement for specialists like the California spotted owl. Forest stands that have been highly modified from prehistoric conditions are restored to diverse old-growth forest status at sufficient levels to maintain species integrity and viability.

B. Objectives

Objective SAR-1. Region-wide consistency in the methods and criteria used to evaluate habitats of wildlife, fish, management indicator, sensitive, and threatened and endangered species during land and resource planning is achieved on each of the Sierra Nevada national forests.

Objective SAR-2. Management strategies are consistent among the national forests and based on current knowledge of the habitat needs for species of concern, including focal, sensitive, threatened and endangered species.

Objective SAR-3. Landscape analyses identify the variety of important wildlife attributes, including:

- Areas important for providing habitat connectivity
- Important structural complexity, including dead trees, snags and fallen logs
- Riparian and aquatic ecosystems
- Disturbance processes needed to maintain or develop habitat structures
- Concentrations of endemic species

These analyses evaluate existing conditions, identify opportunities to maintain or restore conditions, and set priorities for action to species with the highest risk of decline or threat.

Objective SAR-4. Sierra Nevada national forests' management principles include the restoration and maintenance of connectivity in the forest landscape; habitat diversity across the forest landscape; structural complexity in forest stands, including dead trees, snags and fallen logs; and the integrity of riparian and aquatic ecosystems.

Objective SAR-5. Improved habitat quality and connectivity has resulted in the spread of fisher northward from the southern Sierra. Through this dispersal process, the fisher population on the southern forests is no longer isolated from populations in the Klamath Region and beyond.

Objective SAR-6. Habitat and population monitoring of special status species is undertaken as specified in science-based monitoring plans, and management direction adapts to the results acquired by monitoring efforts. If monitoring indicates uncertainty with regard to management effects on a protected species, management actions and plans should be revised with a more conservative approach until effects are known.

Objective SAR-7. Species are selected for monitoring which maintain significant life-cycle functions on federal lands and there dependence of national forest lands is documented in the forest plan record.

C. Standards

General Standards

Standard SAR-1. Forest Service planners adhere to population viability objectives unless and until they have made a scientific determination that conditions beyond Forest Service authority make it impossible to maintain a population's viability.

Standard SAR-1. Complete surveys in suitable habitat for threatened, endangered or sensitive species prior to making management decisions for site-specific activities that may affect such suitable habitat.

Standard SAR-3. Vegetation management projects must specifically define how the project design will support the disturbance regimes that create habitat conditions for species dependent on snags, logs, burned landscapes, frequent fire, etc. for their persistence.

Standard SAR-4. Ground disturbing projects affecting species at risk in all allocations except Community Zone (CZ) must be designed to improve habitat conditions or improve the likelihood of species persistence.

Standard SAR-5. Implement conservation measures identified in Appendix A for the noted species.

Species Specific Standards and Conservation Measures

Species specific standards and conservation measures are present in Appendix A for the species listed in Table IV E-1.

Table IV E-1. Species for which conservation measures have been designed and are presented in Appendix A.

Scientific Name	Common Name	Reason for Inclusion
Oncorhychus mykiss aguabonita	California golden trout	Species at risk
Oncorhychus mykiss aquilarum	Eagle Lake rainbow trout	Species at risk
Oncorhychus mykiss subsp	Goose Lake redband trout	Species at risk
Mylopharodon conocephalus	Hardhead	Species at risk
Lampetra hubbsi	Kern brook lamprey	Species at risk
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	Species at risk
Catostomus platyrhynchus	Mountain sucker	Species at risk
Rinichthys osculus. subsp	Owens speckled dace.	Species at risk
Rana sierrae and R. muscosa	Mountain yellow-legged frog	Species at risk
Bufo canorus	Yosemite toad	Species at risk
Ursus americanus californiensis	Black bear	Species of interest
Martes pennanti	Pacific fisher	Species at risk
Martes caurina[2]	Pacific marten	Species at risk
Gulo gulo	Wolverine	Species at risk
Strix occidentalis occidentalis	California spotted owl	Species at risk
Strix nebulosa	Great gray owl	Species at risk
Accipiter gentilis	Northern goshawk	Species at risk
Dryocopus pileatus	Pileated woodpecker	Species of interest

Table IV E-2. Species for which conservation measures will be developed and presented in the electronic version of Appendix A posted on www.sierraforestlegacy.org by October 2012.

Scientific Name	Common Name	Reason for Inclusion
Empidonax traillii	Willow flycatcher	Species at risk
Centrocercus urophasianus	Greater sage grouse	Species at risk
Picoides arcticus	Black-backed woodpecker	Species at risk

[2] Taxonomic review has identified martens west of the Rocky Mountain crest as a separate species (Pacific marten, *Martes caurina*) from those to the east (*Martes americana*) (Dawson, N. G. and Cook, J. A. In press. Behind the genes: Diversification of North American martens (*Martes americana* and *M. caurina*). In: K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk, editors. *Biology and conservation of martens, sables, and fishers: a new synthesis*. Cornell University Press, Ithaca, New York.)

D. Regionwide Land Allocations

The following land allocations have been defined for species at risk. See Appendix A for the standards that apply to each land allocation.

Table IV E-3. Land allocations for species at risk.

Land Allocation	Definition	Management Objective
Protected Activity Center (PACs)	Designation around known nesting sites for California spotted owl (300 acres), northern goshawk (200 acres), and great gray owl (50-200 acres). Inclusion in the PAC of the area within 300 feet of human structures is avoided.	Provide habitat conditions to support successful reproduction. Treatments of PACs, when allowed, must be monitored to assess effects to target species.
Home Range Core Area (HRCA)	Area around California spotted owl nest site and including the PAC. Size ranges from 600 acres to 2,400 acres depending on location in the Sierra Nevada.	Maintain high quality foraging and nesting habitat. Retain greater than 70% canopy cover in close proximity (up to ½ mile distance) to the PAC or nest stand.
Forest Carnivore Den Sites	Den site buffer (700 acres for fisher; 100 acres for marten) designated around known maternal or natal dens.	Limit disturbance during denning (limited operating period). Retain habitat conditions that support denning, such as over-fisher cover, large down wood, complex understory, and snags. Limit management actions to the reduction of surface and ladder fuels to meet fuel objectives.
Yosemite Toad (YT)	Habitat around sites with YT including wet meadows with standing water and saturated soils, streams, springs, important upland habitat, and habitat identified as "essential habitat" in the conservation assessment for the Yosemite toad.	Provide habitat conditions to support successful reproduction, migration and persistence. Maintain hydrologic function of meadow system. Limit human uses in areas not currently in excellent condition.
Willow Flycatcher: Occupied and Emphasis (WF)	**Occupied habitats** are meadows or riparian sites with documented willow flycatcher. **Emphasis habitat** is defined as meadows larger than 15 acres that have standing water on June 1 and a deciduous shrub component.	Provide habitat conditions to support successful reproduction and persistence. Limit human uses in areas not currently in excellent condition. Maintain hydrologic function of meadow system.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- The Forest Service, in conjunction with state and local agencies and nongovernmental organizations, should support scientific studies to identify key wildlife habitat linkages throughout the state in an effort to address habitat fragmentation and avoid the loss of key wildlife corridors.

- Partnerships with state and local land managers should be created to prioritize and secure linkages and other priority habitats that are not currently protected.

Recommendations for New Regional Direction or Policy

- Ecosystem-based landscape conservation strategies should be a regional level responsibility to ensure that scientifically credible designs are applied across jurisdictions rather than forest-by-forest strategies. The Regional Office should adopt a conservation strategy for the Sierra Nevada region that emphasizes how to address habitat connectivity among the national forests in the revision process and provides direction, oversight and resources for restoration and enhancement of wildlife migration corridors that cross individual forest boundaries.

- Specific objectives and standards for focal species, sensitive species, species of conservation concern, and threatened and endangered species are included in each Forest Plan.

- Sensitive species lists should be reviewed and updated by independent scientists. This information should be integrated into the bioregional assessment and reviewed every five years.

- Focus research efforts on the status of late-succession/old forest-dependent species not adequately monitored by the breeding bird survey approach including: spotted owl, goshawk, flammulated owl, Northern pygmy owl, long-eared owl, Northern saw-whet owl, Vaux's swift, red-naped sapsucker, black-backed woodpecker, willow flycatcher, chestnut-backed chickadee, and varied thrush (Siegel and DeSante 1999).

Additional Recommendations

- The State of California should provide scientific and planning assistance and financial incentives to local governments to develop and implement regional multi-species conservation plans for all of the rapidly developing areas of the Sierra Nevada and Cascades.

- The Sierra Nevada Conservancy should develop a program, closely coordinated with federal, state and local wildlife conservation planning efforts, that prioritizes areas for acquisition and easements based on the needs of wildlife.

- In areas where substantial development is projected, the state and federal land management and wildlife agencies should identify and protect from development those critical wildlife migration or dispersal corridors that cross ownership boundaries and county jurisdictions.

- Public forest lands should be managed to maintain healthy ecosystems and wildlife diversity, including thinning to restore fire-resilient and diverse habitats and reducing the risk of ecologically uncharacteristic wildfire. State and federal forest managers and wildlife agencies should work cooperatively to develop a vision for the future forest condition in cooperation with other experts from the science community.

- State and federal forest managers and state and federal wildlife managers should cooperatively develop timber-harvest cumulative-impact standards, including limitations on clearcutting, for each watershed or group of adjacent watersheds of the Sierra, Cascades and Modoc regions to protect aquatic ecosystems and conserve wildlife habitat.
- State and federal wildlife agencies and federal land managers should jointly develop and implement grazing strategies for the Sierra Nevada and Cascades Region to reduce or eliminate livestock grazing on sensitive habitats to restore the condition of meadow, riparian, aspen and aquatic habitats.

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Species Movement and Habitat Connectivity

Issue Statement

Habitat loss and fragmentation threaten the future integrity of the Sierra Nevada by disrupting important ecological interactions and patterns of movement. Concerns about loss and fragmentation of habitat extend from aquatic to terrestrial systems in this region (Centers for Water and Wildland Resources 1996). Increases in temperature and changes in precipitation due to climate change are likely to exacerbate these effects on habitat through changes in disturbance cycles and seasonal weather patterns. To adapt to climate-driven shifts in habitat, species may need to adjust their range and movement patterns. Barriers to dispersal could result in plant and wildlife populations that are highly vulnerable to extirpation and extinction. Maintaining and re-establishing connectivity of healthy habitats across landscape gradients would facilitate climate-induced species migration and increase the potential for successful adaptation in the face of climate variability and other human induced stressors (Blate et al. 2009, Moritz et al. 2008, Innes et al. 2009).

The concerns about habitat fragmentation and barriers to movement are widespread. The scientific community has been studying the issues related to habitat fragmentation and wildlife persistence for decades. More recently, multiple state and federal agencies have identified the importance of providing for habitat connectivity in the face of climate change and other stressors (Western Governor's Association 2008; Spencer et al. 2010; US Fish and Wildlife Service 2010). Further, the California Department of Fish and Game and other state agencies have determined that a functional network of connected wildlands is essential to the continued support of California's diverse natural communities in the face of both human development and climate change (California Department of Fish and Game 2010).

Planning for Connectivity in the Sierra Nevada

We examined several recent approaches to identifying areas important to sustaining the flow of species and processes across the landscape in an effort to identify attributes that were common among them. We use this information as a basis for our recommendations on how to use the forest plans to address habitat connectivity.

The Sierra Nevada Forest Plan Amendment (USDA Forest Service 2001 and 2004) specifically identified a land allocation focused on enhancing old forest values. This approach was taken, in part, based on recommendations in the Sierra Nevada Ecosystem Project (Franklin et al. 1996). This land allocation, Old Forest Emphasis Area (OFEA), was designed as a network of areas intended to maintain moderate to dense canopy cover across Sierra Nevada landscapes (USDA Forest Service 2001). The OFEAs occupy about 30 percent of the Forest Service land base in the Sierra Nevada. This network largely consisted of internally connected areas and ranged from lower elevation mixed-conifer hardwood types to subalpine areas that intersected with Wilderness Areas. We compared the extent of this network with three recent strategies to identify connectivity in the Sierra Nevada to assess the degree to which the OFEA approach incorporated areas identified as important to connectivity in these independent assessments. The following frameworks were examined:

Framework 1: California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California (Spencer et al. 2010): The California Department of Transportation and California Department of Fish and Game commissioned this project because a functional network of connected wildlands is essential to the continued support of California's diverse natural communities in the face of human development and climate change. The strategy is intended to make transportation and land-use planning more efficient and less costly, while helping reduce dangerous wildlife-vehicle collisions.

Framework 2: Decision Support Maps and Recommendations for Conserving Rare Carnivores in the Inland Mountains of California (Spencer and Rustigian-Romsos 2012): This report provides maps and guidance based on spatially explicit, empirical models intended to support forest planning to sustain populations of four imperiled forest carnivores in the inland mountain ranges of California: Pacific marten (*Martes caurina*), fisher (*Martes pennanti*), wolverine (*Gulo gulo*), and Sierra Nevada red fox (*Vulpes vulpes necator*). The maps depict the distribution of populations and habitat for each species as well as habitat connectivity areas that are important to maintaining species' movements and demographic and genetic processes.

Framework 3: Framework for Cooperative Conservation and Climate Adaptation for the Southern Sierra Nevada and Tehachapi Mountains, California, USA (Southern Sierra Nevada Partnership 2010): This regional conservation framework identifies a network of core areas and connections that support high biodiversity and valuable ecosystem services. The design includes landscape features likely to support adaptation and zones projected to be climatically stable within the existing ranges of common trees and shrubs and key systems.

We examined the degree to which the areas important to conservation and identified in these three assessments overlapped geographically with the OFEAs identified in the existing forest plans in the Sierra Nevada. Our analysis subdivided the 11 national forests in the Sierra Nevada region into five subregions: Northeast California (Modoc National Forest), northern Sierra Nevada (Lassen and Plumas national forests), central Sierra Nevada (Tahoe and Eldorado national forests and Lake Tahoe Basin Management Unit), eastern Sierra Nevada (Humboldt-Toiyabe and Inyo national forests), and southern Sierra Nevada (Sequoia, Sierra and Stanislaus national forests). Our assessment indicated that there was significant overlap among the conservation areas identified in the three studies above and the OFEAs for the northern, central and southern SN subregions (Table IV.F-1). Overlap was substantially less apparent for the other two regions. More specifically, areas determined by these three assessments had fairly high representation in the existing OFEA network on national forests in these subregions.

Table IV.F-1. Evaluation of representation of the Old Forest Emphasis Area land allocation in three frameworks that identify areas important to connectivity (Framework 1: Spencer et al. 2010; Framework 2: Spencer et al. 2012; Framework 3: Southern Sierra Nevada Partnership 2010).

Region (national forest)	Framework 1		Framework 2		Framework 3
	Corridors	Cores	Corridors	Cores	All Priority Areas
Northeast California (Modoc)	5%	26%	0%	98%	n/a
Northern Sierra Nevada (Lassen and Plumas)	60%	48%	65%	92%	n/a
Central Sierra Nevada (Tahoe and Eldorado, Lake Tahoe Basin Management Unit)	74%	47%	77%	73%	n/a
Eastern Sierra Nevada (Inyo and Humboldt-Toiyabe)	17%	2%	15%	15%	73%
Southern Sierra Nevada (Stanislaus, Sierra, Sequoia)	87%	68%	93%	92%	66%

The fairly high degree of coincidence of the OFEA land allocation with these other strategies, designed to specifically address connectivity, indicates that OFEAs are the place to begin in designing a strategy that addresses habitat connectivity for the Sierra Nevada. For the Inyo and Humboldt-Toiyabe national forests, the OFEA land allocation should be revised to incorporate features from the three assessments where geographically appropriate. The Modoc National Forest is not well represented in any of the three assessments and should be examined in light of conservation planning in the Klamath–Siskiyou and Great Basin regions.

Connectivity does not have a universally accepted definition, but generally refers to the effect of terrestrial, freshwater, or marine ecosystem structure on organisms' ability to move and survive within and among patches of resources (Society for Conservation Biology 2010). Connectivity also refers to propagation of processes, such as fire or flooding, or flows of water and nutrients. A successful and effective management strategy in the Sierra Nevada must plan for the connection among all components of the ecosystem by addressing the composition, structures, and processes inherent to the landscape. Further, a successful strategy will require planning and coordination among national forests and other jurisdictions. Absent a robust habitat connectivity commitment, forest plans will struggle to maintain and enhance biodiversity in a changing and uncertain future.

Science-based connectivity strategies must be supported by monitoring to ensure that species movement and viability is the outcome from our best effort to design and implement measures to protect biodiversity.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition CON-1. Connectivity is maintained or restored along gradients of elevation and aspect, linking alpine communities with downslope ecosystems.

Desired Condition CON-2. East-west and north-south connectivity are maintained or restored.

Desired Condition CON-3. Disturbance and other ecological cycles are allowed to function without disruption across the majority of the landscape.

Desired Condition CON-4. Wide-ranging species are able to move freely among habitats.

B. Objectives

Objective CON-1. By year 5 of the forest plan, 50 percent of the roads identified as contributing to fragmentation in the Old Forest and Connectivity (OFC) land allocation have been closed or decommissioned.

Objective CON-2. Opportunities for public-private partnerships to address connectivity and species movement have been explored, documented, and prioritized for action by year two of the forest plan.

Objective CON-3. The forest plan addresses potential effects of changing climate on connectivity and actively plans for shifts in range for species and communities.

Objective CON-4. Landscape analysis and monitoring data will support the identification of restoration actions that reduce fragmentation in the OFC land allocation and that area a high priority for action.

Objective CON-5. Landscape analysis evaluates the potential for changed flow regimes resulting from climate change to create barriers to aquatic species movement. This assessment should include an evaluation of the effect of the water infrastructure (e.g., dams, diversions, conveyances, and culverts) on aquatic connectivity under changed flow regimes.

Objective CON-6. Areas critical for the connectivity of aquatic or terrestrial habitats are managed in the short term to minimize the effects of disturbance and to preserve the functional connection.

C. Standards

Standard CON-1. Road construction is avoided in the OFC land allocation.

Standard CON-2. Stream crossings are redesigned to ensure the movement of water in high and low water years.

Standard CON-3. Projects are designed to enhance connectivity and reduce or eliminate barriers to connectivity that have been identified in landscape analysis.

Standard CON-4. Avoid actions that disrupt habitat characteristics, e.g., hiding or dispersal cover, in areas critical to the connectivity of aquatic or terrestrial habitats, as identified by the OFE land allocation or during other assessment processes.

D. Land Allocations

All land allocations, with the exception of the Community Zone (CZ), can contribute in substantial ways to maintaining connectivity of habitats. Several key land allocations are noted below due to their emphasis on maintaining existing low road density, actively reducing road density, supporting the natural disturbance cycles, and emphasizing protection of biodiversity.

We propose that the land allocations below be used as the starting point for each national forest in assessing landscape connectivity and designing management actions to protect, restore and enhance the connections among habitats. Further, we propose that the existing OFEA land allocation be revised based on on the three studies mentioned above and any other appropriate landscape level assessments to more comprehensively address connectivity and the land allocation Old Forest and Connectivity (OFC) replace the existing OFEA.

Table IV.F-1. Principle land allocations supporting species movement and connectivity.

Land Allocation	General Description	Management Objective
Wilderness Area (WA), Wild and Scenic Rivers (WSR)	Congressionally designated areas.	Preserving the wild nature of these areas
Research Natural Areas (RNAs)	Designated by agreement among the national forest and research station.	Maintain biological diversity Provide baseline ecological information Support non-manipulative research Encourage research and university natural-history education.
Recommended Wilderness (RW)	Area that is recommended for inclusion in the NWPS by the USFS.	Preserve the wilderness character of these lands until Congress accepts or rejects the recommendations in whole or in part.
Backcountry Management Area (BMA)	An inventoried roadless area (IRA) or citizen's inventoried roadless areas (CIRA) that do not contain any national forest system roads or motorized trails.	Preserve the roadless and backcountry character of these lands. Manage them under the Roadless Area Conservation Rule with exception, prohibiting motorized over-snow vehicle use and the construction of new motorized trails.
Old Forest and Connectivity (OFC)	Area in which old forest qualities are emphasized Area critical to the movement and flow of species associated with all habitat types across the landscape. Designed as an adaptation to climate change and other stressors.	Restore ecological process where doing so does not threaten critical values. Maintain movement opportunities across the landscape. Manage to achieve high representation (greater than 60 to 80 percent) of old forest condition.
Riparian Conservation Area (RCA)	Management zones focused on the protection and enhancement of aquatic features	Restore ecological process where doing so does not threaten critical values. Maintain, restore, enhance, and protect. Limited levels of ground and vegetation disturbance allowed. Avoid actions that retard or prevent attainment of aquatic conservation objectives.
Aquatic Diversity Emphasis (ADE)	Watershed in which protecting or maintaining aquatic diversity is the priority.	Restore ecological process where doing so does not threaten critical values. Avoid actions that retard or prevent attainment of aquatic conservation objectives. Promote low road density generally <1.5 mi/mi^2 in the matrix, less in sensitive habitats.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Identify areas within the OFC land allocation in which it is important to limit severe fire as a means to ensure that the habitat connection and quality are preserved; define the appropriate fire management response and incorporate this information into fire plans and other planning documents.

Recommendations for New Regional Direction or Policy

- Provide guidance to the national forests on practices to achieve connected landscapes that draws on the planning and analysis developed by other agencies such as the California Department of Fish and Game (Spencer et al. 2010) and Southern Sierra Nevada Partnership (2010).

- Develop information on the role of climate refugia or climate stable areas in conservation planning and identify for the national forests how to incorporate these areas into the forest plans.

- Convene a multi-agency committee on biodiversity to inform regional and local managers regarding landscape planning, habitat needs, connectivity designs, mitigation of stressors and other issues pertaining to wildlife ecology, viability and movement monitored across the landscape over time.

- Utilize the anticipated report from the panel of experts that will be reviewing the monitoring plan associated with the management indicator species amendment (USDA Forest Service 2007) to inform the development of appropriately scaled designs for population monitoring in the Sierra Nevada.

Additional Recommendations

- Participate in cooperative learning and management projects like the Southern Sierra Nevada Partnership and California Landscape Conservation Cooperative.

- Identify for land trusts land acquisition projects that would make significant contributions to improving connectivity.

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MANAGEMENT OF INVASIVE SPECIES

ISSUE STATEMENT

An invasive or nuisance species is defined as a non-native plant or animal species that adversely affects the habitat and location they invade economically, environmentally, and/or ecologically.[1] Invasive species tend to dominate regions, particular habitats, and/or urban interface land with disturbed landscapes.

The Sierra Nevada is one of the most biodiverse regions of the western United States. While the Sierra Nevada make up only twenty percent of the total land area of California, fifty percent of the native plant species in the state occur within this region (Shevock 1996). This diverse vegetation lends itself to a rich complement of wildlife within the numerous different ecosystem types that exist within the mountain range. Today this famed diversity is at risk due to alterations caused by human use, altered fire regimes, climate change, and invasions by non-native species following these human-caused alterations.

In freshwater ecosystems, invasive species' greatest impacts are demonstrated through their alterations of native food webs, disruption to ecosystem function through predation and/or exclusion of native sensitive species, potential genetic weakening through hybridization with natives, degrading restoration efforts, and dominating the system as a monoculture. Their effects are often unknown and they may become unmanageable once established or naturalized.

Research shows that many invasive plant species are in their early stages of invasion throughout the Sierra Nevada, compared with other regions throughout California at lower elevations (Keeley et al. 2003). However, non-native invasive plants have been found in disturbed sites even at high elevations (Hobbs & Huenneke 1992; D'Antonio et al. 1999). Thus, rapid response to early invaders and instituting a strong prevention program for those that have not yet arrived is essential to the long-term preservation of these pristine wildlands.

In an economic analysis survey conducted by the California Invasive Plant Council (Cal-IPC 2008), data findings showed that federal agencies in California spent approximately $21 million dollars in invasive plant control alone (Cal-IPC 2008). The Lake Tahoe Aquatic Invasive Species Plan estimates that invasive species introductions by species such as quagga (*Dreissema bugensis*) and zebra mussel (*Dreissema polymorpha*), or expansion of aquatic invasive plant populations would create a combined economic cost of approximately $22.4 million a year to recreation value, tourism spending, property values, and increased boat/pier maintenance (USACE 2009) to the Tahoe watershed alone. These staggering cost estimates are examples demonstrating why spending on prevention and early eradication on national forest lands would produce a higher cost benefit ratio than post-infestation control programs.

The forest plan revision process gives an opportunity to examine the existing prevention and control practices being implemented at the forest level to determine the management standards throughout the region. In addition, this process provides an opportunity to expand the breadth of species under consideration. The 2004 forest plan amendment record of decision (ROD) standards and guidelines (#36-49) address noxious weeds, but do not consider aquatic invasive species (USDA Forest Service 2004). In the revision, consideration should be given to a comprehensive invasive species list, design and management measures that can maintain or improve current levels of vector management, control predation of special status species, and minimize further spread of invasive species. It will also be important to consider standardized

[1] Invasive Species Definitions, available at: http://www.dfg.ca.gov/invasives/ and http://en.wikipedia.org/wiki/Invasive_species

management practices for prevention and control of existing and new invasive species.

The Forest Service should maintain and explore new partnerships at Federal, State, local government and nongovernmental levels to focus on restoration, monitoring, rapid response, prevention, and control activities. In addition, region-wide monitoring questions need to be examined that consider the following (D'Antonio 2002):

- What species are demonstrating invasive qualities or hampering native recovery and protection?
- Which habitat types are most commonly being invaded?
- Which species should be prioritized due to their ability to transform landscapes?
- What pathways are promoting their spread so we can limit these introductions?
- What control methods are effective?

A strategic and thorough examination of these questions incorporated into the revised plan will be a crucial step in reducing existing invasive species numbers and minimizing new introductions. Thus, the development of a decision matrix should focus on priority species and prevention, detection, and control actions (Orr 1993).

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition INV-1. Terrestrial and aquatic invasive species are controlled or prevented using management practices that benefit native plants, wildlife, and habitats consistently across all forests.

Desired Condition INV-2. Each forest coordinates on a national, regional, local, and programmatic level to implement an early detection and rapid response plan for invasive species.

Desired Condition INV-3. Practices to prevent the introduction, establishment, and spread of invasive species, such as the use of equipment and materials that are free of invasive species and their propagules, are included in plans, projects and on-going programs.

Desired Condition INV-4. Spread of established invasive species and introduction of new invasive species is minimized to a no-net gain.

Desired Condition INV-5. A robust monitoring program ensures that the entire landscape is thoroughly inspected for invasive species occurrences.

Desired Condition INV-6. An annual risk assessment, based on monitoring results and potential future invasive species, is performed to evaluate risk and prioritize species and management actions leading to clear reductions in invasions.

Desired Condition INV-7. A comprehensive outreach campaign is conducted to all user groups on prevention activities.

Desired Condition INV-8. The Forest Service recognizes that maintaining intact, functioning ecosystems with a full range of native species is the first line of defense in the prevention of invasion.

B. Objectives

Objective INV-1. Perform a risk assessment for all potential invasive species by year 5 of the plan. This assessment should be based on the species' threats to ecosystem function, native species populations and habitat, economics, recreation or other forest value. The presence or absence of vectors for that species and the potential for establishment of that species should also be considered in the risk assessment. Such plans should:

- Identify invasive species distribution and encroachment at multiple scales (e.g., stand level, watershed, forest and region).
- Evaluate risks of invasive species to native plants and wildlife in the region.
- Assess the impact of invasive species on biodiversity trends in the region.
- Evaluate the contribution of invasive species to changes in fire frequency and intensity.
- Assess the contribution of management and other human activities on the forest to invasive species introduction and spread including forestry, dams and other water diversions, off-highway vehicles, temporary and permanent roads, livestock and packstock, mining, and recreational watercraft so that targeted vector prevention measures can be implemented to help minimize future spread and invasion.
- Evaluate the potential effects of climate change on invasive species distribution and risks for new invasions and within the context of synergy of stressors.
- Consider leading edge vulnerability areas for climate change, such as bass moving upstream as water warms.

Objective INV-2. Prepare control and prevention plans for high priority invasive species identified in Objective INV-1.

Objective INV-3. Implement an integrated pest management (mechanical, chemical, and biological controls) approach for all invasive species of concern that includes evaluating the effectiveness of control practices per ecosystem and invasive species of concern.

Objective INV-4. Establish region-wide consistency in the prevention and control standards.

Objective INV-5. Update invasive species watch lists annually in coordination with regional partners and researchers.

Objective INV-6. Monitor populations annually and actively manage populations to decrease potential spread.

Objective INV-7. Maintain GIS layer for emergency fire response plans including: waterbuckets, staging areas, fuel breaks, etc. and locations of invasive aquatic species. Use this information to undertake emergencies actions in ways that minimize the risk of spread.

Objective INV-8. Post-5-year review, increased measures will be taken to halt continued vector advancement due to program related re-introductions of invaders in treated areas.

Objective INV-9. Chemical treatments will not be utilized as a means of controlling native vegetation.

Objective INV-10. Plan, projects and on-going programs will continue to select native species for restoration as a target over desirable non-native species.

C. Standards

Standard INV-1. All projects or permits shall incorporate design measures to prevent the introduction and spread of invasive species.

Standard INV-2. Project decisions that result in land disturbance shall include an invasive species assessment that includes design criteria to limit introduction and spread, and reduce the extent of invasive species that are a high priority for treatment.

Standard INV-3. Ensure that management strategies do not interfere with special status species restoration and protection efforts.

Standard INV-4. Emergency fire response plans address concerns about the introduction and spread of invasive species and identify critical resources that could be affected by emergency response actions such as water bucket sites, staging areas, fuel breaks, etc.

Standard WM-5. In selecting among the methods to manage invasive species, the selected method shall pose the least risk of damage to surrounding organisms and ecosystems, while accomplishing management goals.

Standard WM-6. Use herbicides or pesticides for eradication only when an interdisciplinary analysis has determined that:

- Other methods are unlikely to be successful; and
- All appropriate measures to minimize risk of adverse impacts to non-target organisms have been identified and will be implemented.
- Monitoring of effectiveness of chemical control measures both effects and risk to non-target species and success in limiting invasions.

D. Regionwide Land Allocations

None specifically identified for this resource area. Desired conditions, objectives and standards apply to all land allocations.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Coordinate with other regions on encroaching invaders and methodology.

- Consult with UC Cooperative Extension and the Lake Tahoe Basin Weed Management Group on their development of "A Builder and Contractor's Guide to Preventing the Introduction and Spread of Invasive Weeds," as an example to effective best management practices.

Recommendations for New Regional Direction or Policy

- The Region adopts a conservation strategy for the Sierra Nevada region that emphasizes how invasive species connect among the national forests and identifies practices that limit spread and establishment.

- The Region identifies a regional plan for invasive species and coordinates on specific actions and priorities in each forest.

- The Region performs a programmatic level NEPA and ESA analysis for prevention and control methods for specific types of invasive species actions.

Additional Recommendations

- Promote the development of invasive species management plans to owners or operators of reservoirs or other water bodies that include actions to mitigate expansion into other areas.

- Promote the adoption of an aquatic invasive species plan by the State of California. The implementation of such a plan should be coordinated with the respective national forest, e.g., watercraft inspection programs.

- Developing agreements with academic institutes to broaden scientific input.

INVASIVE SPECIES OF CONCERN IN THE SIERRA NEVADA

The species in the following list have demonstrated invasive qualities and potentially pose a risk to the preservation and restoration of national forest lands within the Sierra Nevada. This is not a complete list, but rather a broad look at species to consider for evaluation and possibly management. In some areas these species may have become unmanageable due to naturalization. The Generic Non-indigenous Aquatic Organisms Risk Analysis (Orr 1993) adapted to incorporate vector identification and management (Orr 2003 in Ruiz and Carlton 2003) may serve a useful basis for the decision matrix when considering these species.

Some of the species below are game species, e.g., rainbow trout, and may be desirable in some environments. The identification of an invasive species that merits eradication is dependent on a variety of factors, including risk to target species or ecosystem functions and ability to eliminate. This is the primary reason we recommend that an assessment be completed for each species under consideration.

Table IV.G-1. A selection of species that have demonstrated invasive qualities and potentially pose a risk to the preservation and restoration of national forest lands in the Sierra Nevada bioregion. Ratings for plants taken from Cal-IPC (2012).

PLANTS and FUNGI			
Scientific Name	**Common Name**	**Cal-IPC Rating (plants only)**	**Notes**
Ailanthus altissima	Tree of Heaven	Moderate	
Cardaria draba	Hoary cress	Moderate	
Carduus nutans	Musk thistle	Moderate	Low elevations only
Centaurea maculosa	Spotted knapweed	High	
Centaurea diffusa	Diffuse knapweed	Moderate	
Acroptilon repens	Russian knapweed	Moderate	
Centaurea solstitialis	Yellow starthistle	High	
Chondrilla juncea	Rush skeletonweed	Moderate	
Chrysanthemum leucanthemum	Oxeye daisy	Not rated	
Cirsium arvense	Canada thistle	Moderate	
Cirsium vulgare	Bull thistle	Moderate	Managing infestations
Cronartium Ribicola	White pine blister rust	Not rated	Fungus
Cytisus scoparius	Scotch broom	High	
Dipsacus fullonum	Teasel	Moderate	
Dittrichia graveolens	Stinkwort	Moderate	
Egeria densa	Brazilian egeria	High	Aquatic plant
Hydrilla veticillata	Hydrilla	High	Aquatic plant
Hypericum perforatum	Klamathweed	Moderate	
Lagarosiphon major	Oxygen weed	Not rated	Aquatic plant
Lepidium latifolium	Perennial pepperweed	High	
Limnobium laevigatum	South American spongeplant	Not rated	Aquatic plant
Linaria genistifolia ssp. dalmatica	Dalmatian toadflax	Moderate	
Linaria vulgaris	Yellow toadflax	Moderate	
Myriophyllum aquaticum	Parrot feather	Not rated	Aquatic plant
Myriophyllum spicatum	Eurasian watermilfoil	Not rated	Aquatic plant

PLANTS and FUNGI			
Onopordum acanthium	Scotch thistle	High	Low elevations only
Potamogeton crispus	Curlyleaf pondweed	Not rated	Aquatic plant
Potentilla recta	Sulfur cinquefoil	Not rated	
Taeniatherum caput-medusae	Medusahead	High	
Tamarix spp.	Tamarisk/saltcedar	High	
Trapa natans	Water chestnut	Not rated	Aquatic plant
INVERTEBRATES			
Scientific Name	**Common Name**	**Status**	**Notes**
Dreissena polymorpha	Zebra mussel	N/A	
Dressena bugensis	Quagga mussel	N/A	
Potamopyrgus antipodarum	New Zealand mudsnail	N/A	
Corbicula fluminea	Asian clam	N/A	
Bythotrephes longimanus	Spiny waterflea	N/A	
Didymosphenia germinata	Didymo or Rock snot	N/A	
AMPHIBIANS /REPTILES			
Scientific Name	**Common Name**	**Status**	**Notes**
Rana catesbeiana	Bullfrog	N/A	Widespread
Trachemys scripta elegans	Red-eared slider	N/A	West-slope Foothills
Ambystoma mavortium mavortium/Ambystoma mavortium nebulosum	Barred tiger salamander/ Arizona tiger salamander	N/A	South-western slope of Sierra.
FISHES			
Scientific Name	**Common Name**	**Status**	**Notes**
Micropterus salmoides	Large mouth bass	N/A	
Micropterus dolomieui	Small mouth bass	N/A	
Lepomis macrochirus	Bluegill	N/A	
Pomoxis nigromaculatus/annularis	Black /White crappie	N/A	
Ictalurus nebulosus	Brown bullhead catfish	N/A	
Oncorhynchus mykiss gairdneri	Rainbow trout	N/A	Desirable non-native game fish
Salvelinus fontinalis	Brook trout	N/A	Desirable non-native game fish
Salmo trutta	Brown trout	N/A	Desirable non-native game fish
Salvelinus namaycush	Mackinaw/Lake trout	N/A	Desirable non-native game fish
Oncorhynchus nerka	Kokanee salmon	N/A	
Cyprinus carpio	Carp	N/A	
Esox lucius	Northern pike	N/A	
Gambusia affinis	Mosquitofish	N/A	

BIRDS			
Scientific Name	**Common Name**	**Status**	**Notes**
Molothrus ater	Brown headed cowbird	N/A	
Sturnus vulgaris	European starling	N/A	
Strix varia	Barred owl	N/A	

Definitions of ratings for plants (Cal-IPC 2012):

High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate – These species have substantial and apparent – but generally not severe – ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

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TRAVEL MANAGEMENT

ISSUE STATEMENT

The National Forests of the Sierra Nevada region provide outdoor recreation opportunities for literally millions of visitors and local residents each year. These federal lands are also pivotally important for providing clean water and air, as well as critical habitat for myriad wildlife species. A major challenge to the future ability of our National Forests to provide environmental benefits and recreation services is the amount of motorized use and the sheer extent and decaying condition of the Forest Service road system. National Forests in California contain over 47,000 miles of roads – more than the length of the entire U.S. Interstate Highway System and over 10,000 miles of unclassified or non-system routes. Primarily a byproduct from the era of big timber, the overall road system in the National Forests of the Sierra Nevada region is convoluted and unmanageable. Road management on the region's National Forest lands has not responded to the changing recreational needs of our nation, and road-related impacts are leading to a host of environmental problems.

Although roads provide important services to society, their presence can also negatively influence the hydrology, geomorphology, and ecosystem processes on National Forest lands. A wealth of scientific literature exists describing the negative impacts of roads on the landscape (Wilcove et al. 1986; Noss 1987; Lehmkuhl and Ruggiero 1991; Noss and Cooperrider 1994; Franklin and Fites-Kaufmann 1996; Trombulak and Frissell 2000; Gucinski, et al. 2001; Forman et al. 2002; Havlick 2002; Sherwood et al. 2002; Gaines et al. 2003; Switalski et al. 2004; Wyoming Game and Fish Department 2004; Coffin 2007; Dietz 2007; Peters 2009; PRC 2012). Fragmented habitats, polluted waters, failed culverts, and eroded road beds are just a few of many road-related impacts that undermine the natural capacity of our forests to provide clean water and valuable wildlife habitat. Roads also indirectly affect forest ecosystems by allowing for increased human intrusion into sensitive areas of the forest landscape, resulting in easier access for poaching of rare plants and animals, human ignited wildfires, illegal waste disposal, and introduction of exotic species (Noss and Cooperrider 1994; Trombulak and Frissell 2000; Coffin 2007).

Roads have both direct and indirect ecological affects on terrestrial and aquatic ecosystems by changing the dynamics of populations of plants and animals, altering flows of materials in the landscape, introducing exotic elements, and changing the levels of available resources such as water, light and nutrients (Coffin 2007). The road networks on National Forest lands render vast areas of the landscape as "road-affected," with only small patches of isolated habitat uninfluenced by road networks (Coffin 2007). Roads are a significant cause of habitat fragmentation in Sierran forest ecosystems (Franklin and Fites-Kaufmann 1996). Habitat fragmentation alters the distribution of wildlife species across the landscape and affects many life functions such as feeding, courtship, breeding, and migration. In fact, fragmentation from roads and other human infrastructure has been identified as one of the greatest threats to biological diversity worldwide (Wilcox and Murphy 1985, Noss 1987, Wilcove 1987, Noss and Cooperrider 1994). Global warming further compounds the threats of habitat fragmentation and biodiversity loss. As animals migrate due to changing climate, landscape connectivity will be increasingly important to best ensure the survival of many species (Hansen et al. 2001; Holman et al. 2005; Welch 2006; Kettunen et al. 2007). This is especially relevant for forests located along the dramatic elevational gradients in the Sierra Nevada.

The presence of roads on the landscape affects the abiotic components of landscapes (i.e., hydrology, sediment transport, water and air chemistry, and microclimate as well as levels of noise, wind, and light adjacent to roadsides) and impacts the biotic components by altering the morphology of stream and river channels (Coffin 2007). Road networks interact with stream networks, increasing the stream drainage density, the overall peak flow in the stream drainage, and the incidence of debris flows in the drainage basin (Jones et al. 2000). The nearly impervious nature of the often unpaved and under-maintained National Forest road systems causes runoff generation even in mild rainfall events, leading to chronic sedimentation into waterways (Luce 2002), negatively affecting sensitive aquatic habitat and stressing municipal water systems. Excessive road densities directly affect water quality and aquatic values and have been correlated with reductions in pool frequency within a channel, increased sedimentation, and warmer water temperatures (Lee et al. 1998; Coffin 2007).

In a speech delivered on August 14, 2009, Secretary of Agriculture Vilsack stated that “restoration, for me, means managing forest lands first and foremost to protect our water resources while making our forests far more resilient to climate change… In many of our forests, restoration will also include efforts to improve or decommission roads, to replace and improve culverts, and to rehabilitate streams and wetlands.” Reclaiming unneeded and environmentally problematic roads is the first step towards restoring fully functioning, healthy watersheds.

“Right-sizing”[1] the road system is also a prudent fiscal choice. Over the long-term it will save millions, if not billions, of taxpayer dollars in reduced maintenance and mitigation costs while simultaneously creating high-wage, high-skill rural jobs through decommissioning or closing surplus or ecologically harmful roads. Simply in terms of fiscal stewardship, eliminating unnecessary road segments and reducing the huge costs of road maintenance would increase the opportunity for federal dollars to be spent on more productive, beneficial projects. The existing road system is far more expensive than the agency can afford, with a maintenance backlog of well over 1.1 billion dollars in California’s National Forests.

Two policies, known as the *Roads Rule* and the *Travel Management Rule* (36 CFR 212), in tandem provide a sound framework to begin to address the sheer volume of decaying and unnecessary roads and consequent environmental damage. However, neither policy has resulted in a serious streamlining of the road system or the reining in of the ever-expanding motorized footprint. Forest managers in the Sierra Nevada have not met the requirements set forth in the Travel Management Rule, and, instead, are designating extensive motorized systems without first conducting an analysis to determine which roads are environmentally problematic and/or unnecessary, and which roads are affordable given reasonable budget projections over time.

To preserve our outdoor heritage – water, wildlife, forest vegetation, and outdoor recreation – it is imperative to gain control of the Forest Service road system. Right-sizing the transportation system can best be achieved by ensuring the integration of the travel management planning required by regulation (36 CFR 212) with upcoming forest plan revisions. Conducting the appropriate inventories and needs assessments are the first steps in the planning process. An evaluation of land allocations, desired conditions, and management objectives (the elements of the forest plan) will be critical to establishing the requirements and need for the road system. Achieving a well maintained and properly sized road system also depends on the Forest Service leadership establishing a timeline for road improvements or changes to the road system that are identified during the planning process.

[1] “The National Forest System has a transportation system that is not suited to its modern needs and requires realignment to ’right-size’ the system for the future” – US Forest Service Chief Gail Kimbell, May 2009

Policy Actions Needed

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition TM-1. The "minimum road system" necessary to meet the need for safe and efficient travel and for administration, utilization, and protection of NFS lands and resources (36 CFR 212.5 b).

Desired Condition TM-2. A streamlined road system that, over any given 5-7 year time period, can be fully maintained to standard.

Desired Condition TM-3. Motorized vehicles park a maximum of one vehicle length off designated roads and trails.

Desired Condition TM-4. Unauthorized routes restored to natural conditions and unneeded NFTS roads and motorized trails are decommissioned.

Desired Condition TM-5. Reliable and dependable access for resource management and recreation, including to both developed and undeveloped recreational sites throughout the forest system.

Desired Condition TM-6. The wild character of all roadless areas (including citizen inventoried roadless areas) and primitive and semi-primitive non-motorized areas is preserved.

B. Objectives

Objective TM-1. The minimum road system, as determined by Travel Analysis (FSH 7709.55), will be formalized through the forest plan revision process and the roads that are determined to be no longer needed to meet forest resource management objectives will undergo a NEPA analysis, be decommissioned and removed from the Motor Vehicle Use Map (MVUM).

Objective TM-2. Minimize environmental impacts by establishing a minimum road system (36 CFR 212.55) and decommissioning unnecessary roads by 2025.

Objective TM-3. Minimum road system will reflect long-term funding expectations (based on past and anticipated future road maintenance budgets and appropriations) beginning in 2015 and reviewed and adjusted in 5-year assessment periods.

Objective TM-4. Minimum road system meets applicable statutory and regulatory requirements, including compliance with the Clean Water Act, Clean Air Act, Endangered Species Act, any relevant Executive Orders, and implementing regulations.

Objective TM-5. Motorized route density adheres to scientifically accepted thresholds for terrestrial and aquatic species by 2025.

Objective TM-6. Road and trail management objectives on designated routes are approved in writing by a responsible official, and included in the transportation atlas or INFRA (FSM 7711.2) by 2015.

Objective TM-7. Route designations reduce user conflict by providing separate routes for uses which are inherently incompatible – routes that emphasize motorized verses routes that emphasize non-motorized use.

Objective TM-8. Road Best Management Practices (BMPs) are designed to accommodate a 100-year storm event.

Objective TM-9. Education and enforcement activities are adequate to achieve compliance with forest-level Motor Vehicle Use Maps by 2020.

Objective TM-10. Route signage is installed on all system roads and motorized trails describing use status (i.e., open or closed) to assist users with compliance of motor vehicle use regulations. Conduct regular inventories to ensure that the signs are maintained.

Objective TM-12. By Year 5, 40 percent of road decommissioning has been completed and by Year 10, 100 percent of road decommissioning has been completed.

Objective TM-13. Road maintenance adheres to Best Management Practices that incorporate long-term implementation, effectiveness and forensic monitoring program and meets Basin Plan requirements under the California Clean Water Act.

C. Standards

Standard TM-1. Unneeded roads determined through Travel Analysis (FSH 7709.55), are prioritized for decommissioning or conversion to non-motorized trails based on the following criteria:

- To create large roadless patches,
- Protect habitat for sensitive, threatened, and endangered species (minimizing percentage of habitat affected),
- Minimize disruption of wildlife migration and dispersal corridors,
- Limit fragmentation of wildlife habitat,
- Maximize area below a threshold road density for focal species or in Old Forest and Connectivity (OFC) land allocation,
- Minimize noxious weed dispersal,
- Minimize erosion and sedimentation in streams,
- Minimize number of stream crossings,
- Maximize fish passage (miles unobstructed in suitable habitat),
- Minimize road redundancy to recreation and management access points.

Standard TM-2. Watershed/ecological restoration projects must include road decommissioning as part of project activities.

Standard TM-3. There shall be a net decrease in the mileage of roads in all key watersheds. Priority should be given to closing and decommissioning roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems.

Standard TM-4. Adhere to Best Management Practices detailed in the Region 5 Water Quality Management Plan.

Standard TM-5. Incorporate non-native invasive species prevention and control into road maintenance and close/restore routes documented as contributing to the spread of non-native invasive plants into relatively weed-free areas

Standard TM-6. Treat non-native invasive species before roads are decommissioned; follow-up based on initial inspection and documentation.

Standard TM-7. Close or seasonally restrict road use to minimize adverse impacts to wildlife species that require solitude or tolerate only minimal disturbance (e.g., deer wintering areas, forest carnivore movement areas, Yosemite toad dispersal habitat, CDFG essential habitats maps from 2010).

Standard TM-8. Close or seasonally restrict road use when the roads are impassable due to wet conditions to minimize adverse resource damage.

Standard-9. Seasonally close routes in areas important to ungulate populations during sensitive seasons (i.e., calving/fawning period for known key ungulate calving/fawning areas, critical ungulate wintering habitat/winter concentration areas, migration corridors during migration).

Standard TM-10. Establish a long-term monitoring program to identify resource damage and ensure that the goals and objectives for management of the NFTS are being met:

- Monitor for the amount of erosion occurring
- Map stream crossings without culverts or bridges and note stream sedimentation levels and visible soil/channel impacts in these areas
- Identify areas of significant amounts of bare soil or route-widening along routes through photos and route width measurements
- Monitor closed and restored routes to ensure the measures taken are effectively mitigating impacts to forest soils
- Monitor routes for sensitive, threatened, and/or endangered plants and animals
- Monitor for unauthorized spur routes into areas with sensitive, threatened, and endangered plant and animal species
- Monitor routes for presence and spread of non-native species or the decline of native species
- Monitor routes to identify whether they are impacting the reproduction, nesting, or rearing of key indicator species
- Monitor use concurrently with local wildlife populations to determine the impact on wildlife species
- Monitor to identify whether there are unauthorized spur routes in roadless areas, Research Natural Areas, citizen or agency proposed Wilderness, Wilderness Study Areas, and other lands with Wilderness character.

Standard TM-11. All unneeded NFTS roads and trails identified through Travel Analysis (FSH 7709.55) for decommissioning will be physically closed upon issuance of the Motor Vehicle Use Map and are treated to prevent hydrologic damage including from severe weather events (i.e., storm-proofed).

Standard TM-12. Vegetation management projects must include a commitment to decommission or prevent use (e.g., barriers and signage) of non-system roads within the project boundary simultaneously with the implementation of the project.

D. Regionwide Land Allocations

Table IV H-1. Land allocations related to road management.

Land Allocation	Definition	Management Objective
Wilderness Area (WA)	Area that is designated or proposed for designation as wilderness.	Preserve the roadless character of these lands.
Recommended Wilderness (RW)	Area that is recommended for inclusion in the National Wilderness Protection System by the USFS.	Preserve the wilderness character of these lands until Congress accepts or rejects the recommendations in whole or in part.
Backcountry Management Area (BMA)	An inventoried roadless area (IRA) or citizen's inventoried roadless areas (CIRA) that do not contain any national forest system roads or motorized trails.	Preserve the roadless and backcountry character of these lands. Manage them under the Roadless Area Conservation Rule with exception, prohibiting motorized over-snow vehicle use and the construction of new motorized trails.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- As part of Subpart A (36 CFR 212.5) implementation and minimum system identification, establish an accurate baseline NFTS as documented through previous management decisions that includes:

  1) Comprehensive look at the NFTS to determine what previous travel management decisions have been made including a records search of all previous transportation-related NEPA decisions and decisions containing transportation-related aspects. Through this evaluation, identify the proper administrative status of all roads (i.e., identify whether roads are temporary or permanent, which roads were scheduled to be closed or decommissioned, the operational and objective maintenance levels, and the road management objectives). Update the infrastructure (INFRA) geographic information system (GIS) application and database to correctly reflect past agency actions, including removing any user-created or other unauthorized roads that were added to INFRA as system roads without supporting decisions; and
  2) Complete an on-the-ground inventory of the location and condition of motorized routes. Document unauthorized roads, but maintain this data in a separate (non-INFRA) database to ensure user-created roads are not analyzed as part of the minimum system. Place all unauthorized roads on a list of roads to be decommissioned and (during the analysis phase) incorporate these roads into the prioritization scheme for decommissioning system roads, based on priority watersheds and wildlife corridors.

- To meet the minimum system requirement of 36 CFR 212.5 b, conduct a comprehensive science-based analysis (Travel Analysis) of the NFTS (maintenance levels 1-5) at the large watershed or District scale that includes the following minimum elements:

  1) Analysis of *all* motorized travelways, not just passenger vehicle roads
  2) Analysis of environmental impacts, especially to water quality, soils, rare plants and wildlife, including calculation of combined road and motorized route density for the entire planning area using technologically current spatial analyses that incorporate species-specific data and result in site-specific road density information, as opposed to large-scale average road density information. This analysis should include all motorized travelways, e.g., open and closed system roads, motorized trails, and unauthorized user-created routes, as these often function ecologically as roads. Particular attention should be paid to road/motorized route density in riparian areas, headwater areas, and sensitive wildlife habitat. Analysis should use scientifically-based density standards as set in previous forest plans, or, if standards are not in place, then the agency should incorporate existing science that articulates density thresholds for key wildlife species. The following elements should be included in the analysis: a) impacts to viability and recovery of Management Indicator Species (MIS) and species of special concern, b) aquatic indices that measure stream health, fish population and trend data, c) affects of proposed road system on roadless areas, quiet zones, watersheds, and wildlife corridors. The analysis should be conducted at both a site-specific and a larger landscape/watershed scale, as impacts are difficult to accurately assess in an evaluation that only considers individual roads in isolation. The analysis should also include an evaluation of the proposed road system on compliance with

Clean Water Act (including Total Maximum Daily Load standards and any additional state level minimum standards), Clean Air Act (including ambient air quality standards and state implementation plans), Endangered Species Act, and other relevant laws, standards and best practices.

3) Analysis of importance to recreation and resource management access, including addressing conformance with Recreation Opportunity Spectrum (ROS) classifications, niche determination, Facility Master Plan analysis, forest plan standards and direction, and valid existing rights.

4) Analysis of decommissioning costs (per mile) and the anticipated Forest maintenance budget (average of several years) to ensure that the minimum necessary road system will be consistent with projected budgets and management capacity without relying on maintenance level downgrades or reclassification of roads as motorized trails to reduce costs without reducing mileage.

Recommendations for New Regional Direction or Policy

- Include road decommissioning as a component of the performance evaluation of each Forest Supervisor.
- Create a decommissioning schedule and score card for each national forest.
- Assess the granting of road access across national forest lands on habitat fragmentation, water quality, wildlife, increased unauthorized use of public lands, increased fire risk, road maintenance costs and other factors associated with increased roaded areas.

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PROTECTING ROADLESS AREAS AND RECOMMENDING NEW WILDERNESS

ISSUE STATEMENT

Protecting Wildlands

Over the decades the Sierra Nevada has been laced with roads to support mining, logging, early settlement, modern urbanization, energy development, water management and even recreation. As a result, more than 26,000 miles of roads currently exist in the Sierra Nevada's national forests (Sierra Nevada Science Review, 1998). Despite this, a great deal of wild country remains, largely as a result of the establishment of some of the most spectacular national parks in the United States and because of the passage of the Wilderness Act of 1964.

Congress passed the Wilderness Act to "secure for the American people of present and future generations the benefits of an enduring resource of wilderness" (PL 88-577, Sct. 2). The Wilderness Act established the most protective designation available for federal land, and it provided legislative mechanisms conservationists could use to add areas to the National Wilderness Preservation System (NWPS) in the future.

In 1971 the USFS initiated its Roadless Area Review and Evaluation (RARE) survey in which the agency sought to identify National Forest System (NFS) lands nationwide that met the definition of wilderness as provided in the Wilderness Act (Scott 2004, pg. 80). This survey, known as RARE I, was followed by a second survey known as RARE II that in 1979 concluded that California's national forests included 6.3 million acres of "inventoried roadless areas" (IRA) that met the definition of wilderness (USDA Forest Service 1979). Of this, the agency found that 3,378,000 acres of IRA lands existed in the California portions of the eleven national forests stretching from the Sequoia to the Modoc. After the passage of the California Wilderness Act of 1984 and the Omnibus Public Lands Management Act of 2009, there are now 2,076,000 acres of IRAs remaining in the eleven forests.

Many of the public land controversies in the Sierra Nevada since RARE have involved conservation groups working to stop development projects proposed in roadless areas, trying to get the areas recommended for wilderness designation by the USFS during individual forest planning processes, or to pass legislation that would designate the areas as wilderness.

In response to these two decades of controversy, on October 13, 1999 President Bill Clinton directed then-USFS Chief Michael Dombeck to prepare a plan to protect the remaining national forest roadless areas. The final version of the Roadless Area Conservation Rule (RACR) was approved in 2001 (USDA Forest Service 2000). The policy prohibited most types of logging and all forms of road construction in IRAs. However, the final plan allowed off-road vehicle (ORV) use, mining, and salvage logging in roadless areas not already protected by more stringent, local rules. Despite these compromises, conservationists considered the policy to be a truly historic step forward in the effort to protect national forest wild areas.

How much of the Sierra Nevada remains eligible for wilderness designation?

Conservationists in California always contended that the RARE surveys failed to identify the true extent of wilderness-eligible areas in the NFS. Many believed that dozens of *de facto* wilderness areas were mistakenly overlooked or purposely excluded because they contained valuable timber or other resources, or because of perceived conflicts with ORV recreation. In addition, while much has changed since the RARE surveys were completed, the IRA maps have never been updated.

As a result of these concerns, the California Wilderness Coalition (CWC) conducted a Citizens Wilderness Inventory (CWI) of roadless land in the

Golden State from 1998-2001. Areas were determined to be eligible for wilderness designation if, as is stated in the Wilderness Act of 1964, they:

- "...generally [appeared] to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable";
- "...[had] outstanding opportunities for solitude or a primitive and unconfined type of recreation";
- "...[were] 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
- "...may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

The CWI was the first attempt by any governmental or non-governmental organization to conduct a comprehensive survey of California's wilderness-eligible lands. From 1998 to 2001 it consisted of the following steps:

1. Using all available USFS, National Park Service (NPS) and Bureau of Land Management (BLM) maps to identify the preliminary boundaries of unroaded areas for further review.
2. Reviewing hardcopy aerial photographs of the areas identified in step 1. This required CWC staff to visit the headquarters of every USFS, BLM and NPS unit in the state. Substantially disturbed areas were excluded from the CWI, including many IRAs that had been developed since the RARE surveys.
3. Draft 7.5 minute topographic maps of wilderness-eligible areas were produced after the aerial photo analysis. The boundaries of these draft maps were then verified in the field by staff and volunteers who surveyed them by foot, vehicle, or mountain bike. All human-caused intrusions were carefully documented with notes and photographs. For each intrusion, the surveyor determined whether or not the disturbance was so great that it had to be excluded from the wilderness-eligible area. In addition to documenting damage, surveyors also noted and photographed positive wilderness attributes such as wildlife, scenery, pristine streams and other features and values. The average wilderness-eligible area required at least 20 hours to survey, and often much more time than that.
4. The data from the field was then used to develop final maps of these citizen-inventoried roadless areas (CIRA).

Between 2002 and 2009 the CWI maps were used as the starting point for successful wilderness legislation affecting Sequoia-Kings Canyon National Park, Pinnacles National Monument, Joshua Tree National Park, the BLM's Ukiah, Arcata, Hollister, Palm Springs-South Coast and Ridgecrest field offices and the San Bernardino, Angeles, Inyo, Mendocino, Six Rivers, Humboldt-Toiyabe and Los Padres national forests. Where necessary and appropriate during public comment periods on proposed development projects or management plan revisions CWC and other organizations have asked agencies to protect CIRAs from development. Most notably during the Angeles, San Bernardino, Cleveland and Los Padres land management plan revisions several CWI lands were designated as "other unroaded areas" by the USFS and some were even recommended for wilderness designation.

With the advent of more accurate agency transportation maps, the easy availability of multiple sources of high-resolution aerial photos, and improvements in digital cameras and GPS and GIS technology the CWC began updating the CIRA maps in 2011 and plans to complete its resurvey prior to the start of the scoping periods for each land management plan revision in California. CWC's survey methods today include the preliminary identification of potential roadless areas using multiple agency GIS layers, the careful examination of at least two sets of high-resolution aerial photographs per wilderness-eligible area and verification of the boundaries in the field. In this analysis the CWC's goal is to exclude all of the following from the CIRAs:

- With some exceptions, all legally-open roads and motorized trails
- Areas that are excessively marred by illegal vehicle use
- Heavily-logged areas
- Large, maintained plantations
- Heavily-developed private land
- Campgrounds
- Reservoirs (not including a few small stock ponds)
- Areas covered by extensive type-conversions
- Maintained fuelbreaks sometimes described as "shaded fuelbreaks" or defensible fuel profile zones (this does not include mere bulldozer lines constructed during fires)
- Helispots
- Drafting sources
- Communication sites
- Heavily mined areas
- Utility corridors

Despite this, some of the CIRAs include:

- A small amount of forest that may have been logged. While the CWC sought to exclude all heavily-logged areas and obvious plantations it is quite possible that a few areas were overlooked. Regardless, it is worth noting that the NWPS includes many areas that were either partially or completely logged, so the Wilderness Act does not require that an area be unlogged for it to be designated as wilderness.
- Minor historic mining disturbances. Major disturbances were excluded. (Note that old mines and other signs of mineral development exist throughout the NWPS).
- Roads and motorized trails that are no longer legally open to the public. For the most part these routes are recovering because they are rarely or never used. However, some of them continue to experience a certain degree of unauthorized use.
- Developments associated with grazing allotments. These features exist throughout the NWPS, so they were not excluded.
- Bulldozer lines constructed during fires. Since bulldozers are allowed in designated wilderness during fires and because there are ridges scarred by these machines throughout the NWPS, CWC did not exclude all of these lines.

In 2001 the CWI identified 7.4 million acres of land in over 300 separate areas that still qualified for wilderness designation on federal lands in California. This total included 5,254,228 acres of NFS land, which is 16 percent more than the 4,417,000 acres of RARE IRAs that existed at the time that the RACR was finalized in 2001.

The value of roadless areas

The RACR final environmental impact statement (USDA Forest Service 2000, Volume 1, pages 3-7) provides an excellent summary of several of the ecological and social values that roadless areas provide, including:

- Clean water for domestic, agricultural, and industrial uses, that helps to maintain abundant and healthy fish and wildlife populations, and that provides the basis for many forms of outdoor recreation;
- Undisturbed or less disturbed habitat that conserves native biodiversity by providing areas where nonnative invasive species are rare, uncommon, or absent;
- Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land;
- Opportunities for people to enjoy high-quality non-motorized recreation activities,

including hiking, camping, mountain biking, picnicking, wildlife viewing, hunting, fishing, cross-country skiing, swimming and whitewater boating;

- "Reference landscapes" that can provide comparison areas for scientists seeking to evaluate and monitor the differences between natural settings and more intensely managed areas;
- High quality scenery that contributes directly to local tourism and to real estate values in neighboring communities; and
- Many important Native American cultural sites and valuable historical resources.

In addition, even a cursory glance at maps of the Sierra Nevada reveals that the remaining roadless areas tend to be much lower in elevation on average than many of the areas that are currently designated as wilderness. This is important because the diversity of flora and fauna generally increases as elevations decrease (Noss and Cooperrider 1994).

On April 14, 2009 one hundred twenty-seven scientists sent a letter in support of the RACR to President Barack Obama. The scientists provided a good summary of the ecological benefits of roadless areas:

> Scientific research has amply documented the greater health and resiliency of intact forest ecosystems versus those disturbed by roads and logging. Less disturbed forests are less susceptible to tree diseases, insect attacks, and invasions from non-native species, and less likely to have suffered the adverse effects of fire suppression. These healthier ecosystems are in turn more able to withstand the effects of global climate change and act as refugia for sensitive wildlife and plant species, many of which are vulnerable to extirpation in more developed areas. Thus, intact forests can serve as vital reservoirs and safety nets, as surrounding landscapes become genetically impoverished and fragmented, greatly impeding species' abilities to adapt to the increasing stress of global warming. Intact forests play an important role in the function of watersheds and aquatic ecosystems. They are spared the potentially massive soil erosion that can accompany road building and logging, which fouls streams and rivers. As a result, roadless areas in our national forests contain some of the most intact aquatic ecosystems in the country, including some of the healthiest salmon stocks. Intact forests provide direct watershed benefits to people by reducing flood threats and supplying clean sources of drinking water. In fact, National Forests and Grasslands are the largest single source of water in the continental U.S., contributing nearly 20 percent of the Nation's water supply (Alcock et al. 2009).

Despite these important values, roadless areas face an uncertain future in the Sierra Nevada because:

- The current political climate in some regions makes the prospect of a locally-sponsored wilderness bill unlikely;
- Roadless lands outside of IRAs, such as those identified during the CWI, are not covered by the RACR;
- The existing management plans for the eleven Sierra forests recommend to Congress that only 56,000 acres of IRAs be designated as wilderness, and these recommendations can be rescinded in the next round of plan revisions;[1] and
- Even where wilderness recommendations have been made, such as in the Lassen and Eldorado national forests, activities, such as increased OHV use, are allowed that can degrade an area's wilderness character over time.

[1] Additional acres were recommended for wilderness designation in the Inyo National Forest and the Humboldt-Toiyabe National Forest. A portion of this recommendation was rescinded and the rest was designated as wilderness.

Current minimum requirements for addressing roadless area issues during forest plan revisions

According to the USFS' planning regulations at 36 C.F.R. § 219.7(c)(2)(v), the agency is required 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."

The Forest Service Manual (FSM) 1923.03 and Forest Service Handbook (FSH) 1909.12, chapter 70, offer more detail regarding the areas that must be evaluated:

> 3(a). Newly identified roadless, undeveloped areas and areas (1) previously identified in the Forest Service Roadless Area Conservation Final Environmental Impact Statement (Volume 2, November 2000), (2) in a unit plan, or (3) in a land management plan, which remain roadless and undeveloped and have not yet been designated as wilderness or for nonwilderness uses by law.
> (b). Areas contiguous to existing wilderness, primitive areas, or administratively proposed wildernesses, regardless of agency jurisdiction for the wilderness or proposed wilderness.
> (c). Areas that are contiguous to roadless and undeveloped areas in other Federal ownership that have identified wilderness potential.
> (d). Areas designated by Congress for wilderness study, administrative proposals pending before Congress, and other legislative proposals pending which have been endorsed by the President.

The FSM and FSH further require that for each area subject to evaluation under paragraph 3 of FSM 1923, the determination of the significant resource issues shall be developed with public participation and, at a minimum, consider:

> 1. The values of the area as wilderness.
> 2. The values foregone and effects on management of adjacent lands as a consequence of wilderness designation.
> 3. Feasibility of management (FSH 1909.12, sec. 72.1) as wilderness, in respect to size, nonconforming use, land ownership patterns, and existing contractual agreements or statutory rights.
> 4. Proximity to other designated wilderness and relative contribution to the National Wilderness Preservation System.
> 5. The anticipated long-term changes in plant and animal species diversity, including the diversity of natural plant and animal communities of the plan area and the effects of such changes on the values for which wilderness areas were created.

Furthermore, as is stated at FSH 1909.12 Chapter 72, the USFS must consider the capability, availability and suitability of each area considered for wilderness designation.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Conditions *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition WILD-1. Lands classified as roadless have increased in total acreage and in their distribution across the Sierra Nevada.

Desired Condition WILD-2. Roadless lands are distributed across the range of habitats found within the Sierra Nevada and are important in the conservation of rare and common species and communities.

Desired Condition WILD-3. Wilderness areas and roadless areas continue to provide the ecological and social benefits described in PL 88-577 and Volume 1, pages 3-7 of the RACR FEIS.

B. Objectives

Objective WILD-1. The backcountry management area (BMA) land allocation is incorporated into individual forest plans.

Objective WILD-2. The recommended wilderness (RW) land allocation is incorporated into individual forest plans.

Objective WILD-3. Except for the areas described in WILD-4 and WILD-5, below, the remaining undeveloped portions of all IRAs and CIRAs are designated as BMAs under individual forest plans.

Objective WILD-4. Existing wilderness recommendations from previous individual forest plan revisions are retained.

Objective WILD-5. After extensive consultation with the public, the IRAs and CIRAs considered most suitable for wilderness designation are managed as RW.

Objective WILD-6. The construction of NFS roads is prohibited in other unroaded areas that are 1,000 acres or larger in size.

C. Standards

Standard WILD-1. Apply the RACR standards and guidelines to the BMA land-use zone but prohibit motorized over-snow vehicle use and the construction of new motorized NFS trails. The BMA standards and guidelines should be consistently applied throughout the eleven Sierra Nevada national forests.

Standard WILD-2. Manage areas in the RW land allocation under the same standards and guidelines that are used to manage designated wilderness. The RW standards and guidelines should be consistently applied throughout the eleven Sierra Nevada national forests.

Standard WILD-3. After extensive consultation with the public, identify the portions of all IRAs and CIRAs that do not contain any NFS roads or motorized trails and place these areas in the BMA land allocation.

Standard WILD-4. Manage areas that were recommended for wilderness designation in previous plans under the RW land allocation until Congress accepts or rejects the recommendations in whole or in part.

Standard WILD-5. Consider public comment and assess all IRAs and CIRAs according to the standards set forth in the FSH to determine whether or not the roadless areas should be recommended for wilderness designation. Deserving areas should be placed in the RW land allocation until Congress accepts or rejects the recommendations in whole or in part.

Standard WILD-6. Map all unroaded areas that are 1,000 acres or larger in size outside of IRAs and CIRAs. Prohibit the construction of NFS roads in these areas except under the circumstances described for IRAs (36 CFR Part 294.12(b)).

D. Regionwide Land Allocations

Table IV.I-2. Land allocations related to roadless and wilderness protection.

Land Allocation	Definition	Management Objective
Wilderness Area (WA)	Congressionally designated areas.	Defined by congressional designation.
Recommended Wilderness (RW)	Area that is recommended for inclusion in the NWPS by the USFS.	Preserve the wilderness character of these lands until Congress accepts or rejects the recommendations in whole or in part.
Backcountry Management Area (BMA)	An IRA or CIRA that does not contain any NFS roads or motorized trails.	Preserve the roadless and backcountry character of these lands. Manage them under the RACR, but prohibit motorized over-snow vehicle use and the construction of new motorized NFS trails.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

To meet the intent of forest planning regulations (36 C.F.R. § 219.17) and to fully address the management of roadless areas, the planning teams on the Sierra Nevada forests should complete the following four objectives during the forest plan revision process:

1. Conduct an inventory of all wilderness-eligible land during the forest plan development process, including roadless areas that are not IRAs. It is impossible to fully understand the ecological and social benefits of roadless areas and the impacts of allocating them to non-wilderness zones without a comprehensive survey of what is and is not roadless. It is therefore essential that planners on each forest accurately map *all* roadless areas, including CIRAs that are brought to their attention by the public, during the forest plan development process. Planners should look for new roadless areas or extensions of known roadless areas that have been created as a result of:
    - Road decommissioning;
    - Travel management plans;
    - Land acquisitions; and
    - Wilderness designations.

   An area should be identified as roadless if it is free of "classified roads" as defined in the RACR at 36 CFR Part 294.11(1).

2. Provide a full description of every roadless area's wilderness qualities and social and ecological values. Planners on each forest should fully describe the wilderness qualities and social and ecological values possessed by every roadless area. The list of at least some of these qualities and values are listed at 36 C.F.R. § 219.17, in the RACR FEIS and in the April 14, 2009 letter from 127 scientists to President Barack Obama in support of the RACR. In addition, forest planners should include wilderness qualities and social and ecological values brought to their attention by members of the public.

3. Provide *full* and *fair* evaluations of every roadless area's wilderness qualities and, if found deserving, recommend them for wilderness designation in the forest plans. Include an explanation as to why the USFS will or will not recommend to higher authorities that the areas be designated as wilderness in whole or in part. A roadless area should be found eligible for wilderness designation and forest planners should

consider recommending it as wilderness if, as is stated in the Wilderness Act of 1964, it:

- "...*generally* appears to have been affected *primarily* by the forces of nature, with the imprint of man's work *substantially* unnoticeable" (emphasis added—as these qualifiers clearly illustrate, Congress did not intend for only pristine areas to be designated as wilderness);
- "...[has] outstanding opportunities for solitude *or* a primitive and unconfined type of recreation" (emphasis added—some have mistaken the "or" for an "and." Also, note that in the context of the Wilderness Act "unconfined" simply means outdoor);
- "...[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
- "...may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Forest planners should provide a *full* and *fair* evaluation of every roadless area's wilderness qualities, followed by an explanation of why the USFS will or will not recommend that the areas be designated as wilderness in whole or in part. We emphasize the word "fair" because it has been rather common for forest planners to use external "sights and sounds" criteria, rather than an area's undeveloped character, to decide whether or not roadless areas should be recommended for wilderness designation. In so doing, the USFS acts contrarily to long-standing direction from Congress to avoid using sights, sounds and other external influences to judge an area's wilderness quality. Areas that are recommended for wilderness designation should be managed in a manner that is consistent with the Wilderness Act until such time as Congress decides whether or not to act on the recommendation.

4. Thoroughly examine the impacts of placing all or portions of an IRA or other roadless area under a non-wilderness prescription. For those roadless areas or portions of roadless areas that are not recommended as wilderness, forest planners should include a thorough examination of the impacts of placing all or part of a roadless area under a non-wilderness management prescription.

   The RACR FEIS offers a detailed description of some of the issues that should be studied, described and discussed for each alternative in a forest plan (see page 3-21 to 3-242). These issues include:

   - The projected amount and impact of road construction in roadless areas;
   - The costs associated with maintaining new roads in roadless areas;
   - The risks of reducing water quality in roadless areas;
   - Impacts to air resources from roadless areas;
   - Economic impacts;
   - Consequences of and for fire and fuels management in roadless areas;
   - Impacts of insects and disease in roadless areas;
   - Impacts to the size of roadless areas (as the RAC FEIS states at 3-136, "There is a positive relationship between size of an area protected from human disturbance and maintenance of biodiversity");
   - Impacts to roadless areas of development at various elevation distributions;
   - Impacts to terrestrial animal habitat, including fragmentation and connectivity, edge effects, habitat suitability and effectiveness, early

successional habitat, game species and late-successional habitat;

- Impacts to aquatic animal habitat and species in roadless areas, including fragmentation and connectivity, water hydrology and stream channel morphology, habitat complexity, water quality, pools, riparian vegetation, introduction of nonnative species and diseases and over-harvest and illegal introduction;
- Impacts to terrestrial and aquatic plant species in roadless areas, including effects of non-native invasives, habitat fragmentation and temporary roads;
- Impacts to threatened, endangered, proposed and sensitive species in roadless areas;
- Impacts to research, monitoring and reference landscapes in roadless areas;
- Consequences for non-mechanized, mechanized and motorized recreation in roadless areas;
- Impacts to scenic quality;
- Consequences to heritage resources; and
- Impacts from roadless area development on existing wilderness and the possibility of future wilderness designation.
- If all or part of a roadless area is allocated to a non-wilderness prescription, forest plans should discuss what mitigation, if any, the USFS proposes for the loss of wilderness characteristics and the effects on plant and animal communities.

Recommendations for New Regional Direction or Policy

- The Region should provide guidance to each national forest on how individual forests are to evaluate roadless areas during the forest plan revision processes. The guidance should support the development of forest plans that protect all roadless areas, both agency-inventoried and citizen-inventoried, in a manner that is at least as protective as the RACR.

- Retire grazing allotments in designated wilderness areas that are no longer in regular use or those wilderness and wilderness study areas that exhibit continued resource damage, limiting attainment of desired conditions for aquatic-riparian resources or TES species, in the first five years of newly revised forest plans.

Additional Recommendations

- Follow up with advocacy work to promote USFS wilderness recommendations in Congress.

- Work with land conservancies, land trusts and the USFS to acquire private inholdings within roadless areas in order to make them more manageable as wilderness.

- Limit all higher elevation wilderness fish-stocking where lakes and streams were originally fish-less.

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Wild and Scenic Rivers: Evaluation and Recommendation

Issue Statement

It is hereby declared to be the policy of the United States that certain selected rivers of the Nation, which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The Congress declares that the established national policy of dam and other construction at appropriate sections of rivers of the United States needs to be complemented by a policy that would preserve other selected rivers or sections thereof in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes.

National Wild and Scenic Rivers Act – 1968

Established by Congress in 1968, the National Wild and Scenic Rivers System is the nation's foremost river conservation tool. The free flowing character and outstanding natural and cultural values of a river, along with its water quality and immediate environment, is permanently protected once Congress adds the river to the System. It is important to recognize the congressional intent in passing the Act is to balance the extensive development of rivers with the protection of the free-flowing character and outstanding values of other selected rivers.

Large segments of natural free-flowing rivers are fast disappearing throughout the United States (Stanford and Ward 1979). River development has been so rampant in the United States that "98 percent of an estimated 5.2 million km of streams are degraded enough to be unworthy of federal designation as wild or scenic rivers" (Benke 1990 in Mac et al. 1998). In California, only a handful of rivers remain in a natural or relatively natural free-flowing state. Of the approximately 194,000 miles of rivers and streams in California, only 6,000 miles (or about 3 percent) are potentially eligible or eligible for wild and scenic protection, or already protected in the state and federal systems (Evans 2001).

Its wide diversity of climate, physiographic provinces, eco-regions, and habitats make California a particularly rich source of potential Wild and Scenic Rivers. Federal lands encompass much of the state's source headwaters and watersheds in mountain ranges, foothills, deserts, and coastal regions. The streams that flow through these federally managed public lands offer numerous opportunities to increase the diversity of rivers and streams represented in the National Wild and Scenic Rivers System. Many of these waterways provide important sources of high quality water for downstream communities; they support numerous sensitive, threatened, and endangered fish and wildlife species; and they offer outstanding opportunities for outdoor recreation. These are important benefits associated with expanding the representation of California's streams and rivers in the National System.

Rivers are identified for possible inclusion in the System through studies conducted by the Forest Service and other federal land management agencies. Section 5(d) of the Wild and Scenic Act requires the Forest Service "in all planning for the use and development of water and related land resources…to determine which additional wild, scenic, and recreational river areas within the United States shall be evaluated in planning reports…" Updated in 1996, the Forest Service Handbook (FSH) requires that the "land management planning process shall include a comprehensive evaluation of the potential for rivers in an administrative unit to be eligible for inclusion in the National System"(FSH 1909.12-81.2).

Federal guidelines outline a two-step process for wild and scenic studies. The first step is to determine whether a stream is eligible for protection. Eligibility is determined by answering two questions: Is the stream free-flowing? Does it have one or more outstandingly remarkable values? The second step is to determine whether a stream is suitable for protection. A positive answer to this question results in the agency recommending to Congress that the stream be added to the National System.

Compliance with section 5(d) of the Act and the Forest Service Handbook was widely variable in the previous round of National Forest plans in Region 5. Only eight of the 18 forests in Region 5 completed at least comprehensive eligibility evaluations in the first round of forest plans. Other forests looked at a subset of streams identified from various sources, but they did not conduct a comprehensive evaluation. Only four forests completed suitability studies and made recommendations to Congress as part of their comprehensive evaluation.

Suitability studies and recommendations were generally punted to the next round of forest planning by thirteen of the eighteen forests in Region 5. The majority of the forests conducted their evaluations prior to the adoption of new planning direction in 1996 in the Forest Service Handbook. The 1996 FSH update included substantial new eligibility criteria, particularly for the identification of outstanding remarkable values.

The 1996 FSH also indicates that the "preferred process is to proceed with determining suitability in the land management planning process" (FSH 1909.12-83.1). In part, this is due to the fact that suitability recommendations are major federal decisions requiring NEPA review. Using the existing NEPA process for Forest Plan revisions to complete suitability studies and make recommendations for potential Wild and Scenic Rivers is the most efficient use of limited federal resources. The alternative is to delay the suitability determination of eligible rivers until a subsequent separate study is completed; however, this may not be preferable since it will require funding and staff resources that are difficult to muster outside the forest planning process. The Tahoe National Forest is one of the few in Region 5 that successfully secured the staff and funding resources to complete post-forest plan suitability studies for eligible streams. Many other Forests in Region 5 have promised but failed to complete post-plan suitability studies.

Altogether, section 5(d) studies conducted in previous forest plans resulted in the recommendation of approximately 879 miles of rivers and streams. An additional 1,037 miles of streams have been determined eligible by the agency but suitability studies and recommendations for these streams remain to be completed in the next round of planning. An undetermined number of streams remain to be studied for both eligibility and suitability on those forests that failed to conduct comprehensive evaluations. An overview of the status of evaluations for each national forest in the Sierra Nevada in presented in Appendix E of this strategy.

As required by the National Wild and Scenic Rivers Act, Section 3(d)(1), the Forest Service must prepare a Comprehensive River Management Plan (CRMP) for river segments designated on or after January 1, 1986. For rivers designated before January 1, 1986, the agency through its "regular planning processes" shall review all boundaries, classifications, and plans for conformity to section 3(d)(1). The CRMP is an essential component of the law's mandate to protect river values, and compliance with this important section of the Act should be a specific objective of the forest plan revision.

There are eight designated Wild and Scenic Rivers located in Sierra Nevada National Forests.[1] Six of these rivers have river management plans completed prior to 1994, with widely varying degrees of sophistication and detail. All the CRMPs are out of date and none are up to modern standards as outlined by the Interagency Wild and Scenic Rivers Coordinating Council.[2] One river designated in 2006 has no CRMP and is well past its 2009 deadline and seven streams designated in 2009 are approaching the three-year deadline. Existing CRMPs should be updated in the forest plan revisions. The Forest Service should use the forest plan revision to complete CRMPs for the recently designated rivers if resources are insufficient to complete CRMPs prior to the revision.

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition WSR-1. River segments "possessing outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations" (Wild and Scenic Rivers Act 1968).

B. Objectives

Objective WSR-1. A comprehensive assessment of all potential eligible Wild and Scenic Rivers is conducted as part of the Forest Plan revision using the latest available resource data and science.

Objective WSR-2. Suitability studies have been completed for all rivers determined to be eligible.

Objective WSR-3. Review and revise existing plans for designated Wild and Scenic Rivers as part of the Forest Plan revision.

Objective WSR-4. Update existing Comprehensive River Management Plans (CRMPs) for designated rivers in the Forest Plan revision. For recently designated rivers with as yet uncompleted CRMPs, use the Forest Plan revision to develop the CRMPs.

C. Standards

Standard WSR-1. Provide interim protection to maintain the free flowing character, specific outstandingly remarkable values, and potential classification of eligible rivers. Prohibit ground disturbing actions within designated distances of eligible or recommended streams until a reach-specific plan has been developed that establishes interim protective management for these area.

Recommended Actions to Address During the Assessment Portion of the Forest Plan Revision

- Complete comprehensive eligibility evaluations during the forest plan revision process for all national forests that did not conduct a comprehensive evaluation in the previous forest plan.

- Use the most updated (1996) planning direction and eligibility criteria for comprehensive eligibility evaluations, particularly for national forests that resulted in limited eligibility findings in the previous plans.

[1] Wild and Scenic Rivers in the Sierra Nevada National Forests include the Middle Fork Feather (1968), North Fork American (1978), Tuolumne (1984), Kings (1987), Kern (1987), Merced (1987), Owens River Headwaters (2009), and Cottonwood Creek (2009).

[2] In the Council's whitepaper, *Newly Designated Wild and Scenic River: Interim Management and Steps to Develop a Comprehensive River Management Plan.*

- Review previous eligibility evaluations in light of updated 1996 planning direction.

- Complete suitability studies for eligible streams identified in the previous forest plans, and recommend to Congress those streams determined suitable.

Recommendations for New Regional Direction or Policy

- Provide direction and support to complete comprehensive eligibility/suitability evaluations for all rivers during the forest plan revision process.

- Provide direction and support for the completion of suitability studies for rivers determined to be eligible during the previous forest planning process. Establish a timeline for completion of suitability studies within the first five years of forest plan adoption.

- Provide direction to ensure that forest plan revisions review the boundaries, classifications, and plans for designated rivers, update existing CRMPs, and complete CRMPs for recently designated rivers.

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SPECIAL INTEREST AREAS AND RESEARCH NATURAL AREAS

ISSUE STATEMENT

Special interest areas (SIA) are authorized under CFR 36 294.1 and defined as areas which should be managed principally for recreation use substantially in their natural condition. They are managed for their unique scenic, geologic, historical, archaeological, botanical, cultural, or other memorable features.[1] Research Natural Areas (RNA) are authorized under Forest Service Manual (FSM) Section 4063 and defined as a physical or biological unit in which current natural conditions are maintained insofar as possible. These conditions are ordinarily achieved by allowing natural physical and biological processes to prevail without human intervention to provide a baseline against which man-caused changes elsewhere can be measured (Moir 1972; Burns et al 1984). RNAs are established specifically to preserve a representative example of an ecological community primarily for scientific and educational purposes.[2] The FSM 4063.1 states: "Research Natural Areas must be large enough to provide essentially unmodified conditions within their interiors. In the West, 300 acres of land is generally considered the minimum size." However, in order to represent a variety of successional stages, landscape patterns, plant associations, and environmental variables, RNAs for some ecosystem types will often need to be considerably larger than 300 acres. Some proposed RNAs in the Rocky Mountain Region currently exceed 5,000 acres. The viability of species and persistence of natural disturbance patterns are also often size dependent (Andrews 1993).

The forest plan revision process is the opportunity to address directly the protection of existing special interest areas (geological, botanical, historical, cultural, etc.) and research natural areas and the establishment of additional areas. In the coming years, it will be critical to enhance these areas and provide additional areas to offer refugia and added buffering of impacts to wildlife brought about by climate change. This may require a network of natural areas be built that represents the full diversity of ecosystems found across the region while recognizing that each site is a dynamic ecosystem that will change over time.

Basic consideration of the designations during the forest plan revision process should include the following:

- Existing designated areas must be preserved in future forest plans.
- Additional areas that are established must be designated with appropriate standards and guidelines and monitoring.
- Coordination of new and existing SIA and RNA areas with other current specially designated areas must be considered:
  a) Specific designated areas within national forest boundaries under specific federal acts include: other agency areas (National parks and Monuments, State parks, F&G wildlife refuges, FERC license areas (reservoirs, etc), Wilderness, Wild and Scenic rivers, Roadless areas
  b) Specific designated areas at the local forest level include: Primitive areas, Research Natural Areas, Special Interest Areas, Experimental forests, Old Forest Emphasis Areas, Vehicle Control Areas, Non-motorized Recreation areas and trails (PCT), Riparian Conservation Areas, Campgrounds, Staging areas (snowmobile, OHV, rafting, equestrian), Ski resorts, Special permits (mining, grazing, race events)
  c) In addition, certain protections are established to provide a diversity of species: PACs, HRCAs, Carnivore Corridors, Deer Migration Corridors, Climate Change Corridors, Management

[1] See Appendix D for existing status of Special Interest Areas for Sierran Forests.
[2] See Appendix D for existing status of Research Natural Areas for Sierran Forests.

Indicator Species, Endangered/Threatened/Special Concern Species, Important Bird Areas.

- Consideration should be given to identify and establish any additional categories that are needed.
- Determination of specific land additions in any of these categories (new wilderness, etc.).

Special Interest Areas are meant to be a destination for recreational opportunities, and so will have direct human impacts. Since Research Natural Areas are not meant to be a recreational destination, the same kind of impacts are not presumed. Specific concerns for each type of interest area that must be addressed in an area-specific management plan include:

- Geological (including paleontology) – human disturbance of caves, vandalism, collecting
- Botanical – invasive species, grazing, timber management, fire (or lack thereof), OHVs, collecting
- Scenic – excessive noise, litter, clearcuts, fire
- Zoological – nest and den disturbance, loss of corridors, invasive species, fire
- Cultural - Cultural resources are especially vulnerable to disturbance; once disturbed or damaged, the information lost is irreplaceable. Disturbance stems from use of metal detectors and shovels to obtain artifacts; in some cases heavy equipment is used. A comprehensive program of public education, site enhancement, 'antiquities' signing, and frequent patrolling will be necessary to reduce vandalism.

Common threats to special interest areas include vandalism, timber projects, vegetation management, fire, flooding, invasive species, and climate change.

Climate change presents a special challenge since the baseline or reference area may change. Climate will also affect biotic populations directly. The new forest plans must ready the Sierra to respond to the major stressors, giving ecosystems and species room to survive and adapt, and ensuring that managers are ready to learn from and respond to change. Decisions will have to be taken in a swiftly changing context, but without sacrificing scientific rigor or public involvement. The new forest plans must, therefore, be designed to guide forest managers for the crucial years ahead

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Desired Condition SA-1. A network of Research Natural Areas represents the full diversity of ecosystems found across the region while recognizing that each site is a dynamic ecosystem that will change over time. Size of the areas must be large enough to adequately represent the plant community or unique ecosystem features to be researched and be protected from destruction (i.e. climate change, uncharacteristic fire, unauthorized OHV entry, etc.). Redundant[3] areas may be necessary to maintain a range of study areas and sufficient population sample sizes.

Desired Condition SA-2. Special Interest Areas of national forest land are designated to protect unique scenic, geologic, historical, archaeological, botanical, cultural, or other memorable features, other than wilderness or wild areas, which should be managed principally for recreation use substantially in their natural condition.

[3] We use the use of the term redundant in the context of ecological systems (Berkes et al. 1998). Spatial redundancy of ecological subsystems is desired for purposes of experimentation and replication. Redundancy of subsystems or components of an ecosystem is also important to conservation planning. Redundancy can reduce the likelihood that elements (e.g., species, rare habitats) will be lost as a result of stochastic events or other stressors.

B. Objectives

Objective SA-1. To reduce institutional barriers to natural and special interest areas designation and improve access to establishment information.

Objective SA-2. To review and improve the standards and guidelines for the management of these areas to ensure their protection and sustainability.

Objective SA-3. To collaborate with the local communities, the scientific community, and other interested stakeholders to solicit input as to what areas should be added to existing RNAs and SIAs in each of the national forests.

Objective SA-4. Ensure that an RNA network is created to preserve a wide spectrum of pristine areas that represent important forest, shrubland, grassland, alpine, aquatic, geological, and similar natural situations that have special or unique characteristics of scientific interest that are part of a national network of ecological areas for research, education, and maintenance of biological diversity. Address the following in the development of the network:

- Develop a timeline for establishing the network
- Preserve and maintain genetic diversity via the network.
- Ensure that regional ecosystems and any associated rare species are represented in the natural areas network now and in the future.
- Reference areas for the study of succession.
- On-site and extension educational activities.
- Baseline areas for measuring long-term ecological changes.
- Control areas for comparing results from manipulative research.
- Monitoring effects from resource management techniques and practices on adjacent forest.

Objective SA-5. Design the RNA network to foster resiliency to changes from serious environmental disruptions such as climate change that will reshape these ecosystems over time.

Objective SA-6. Periodic monitoring of individual RNAs is integrated at the regional level to support evaluation of the RNA network.

C. Standards

Standard SA-1. Create a management plan for each RNA that includes:

- A baseline set of data for the area including vegetation, wildlife, streams, and geology;
- Management practices designed to meet and enhance the objectives of the RNA;
- A monitoring plan for key resources in the area; and
- Annual or periodic process for reviewing monitoring and revising the management plan to ensure that the RNA values are being maintained.

Standard SA-2. Control of fire within Research Natural Areas shall be by methods that cause the least disturbance.

- Inside RNA—Conduct all fuel treatment activities, including the use of planned prescribed fire, in accordance with the plan developed to manage and protect this area. Normally, methods that employ machinery shall not be used. If fire is prescribed, only part of the research natural area shall be allocated for prescribed burning and part shall be reserved for future fire cycles.
- Outside (adjacent) to RNA – Where activity and natural fuels create a threat of a damaging fire carrying into the RNA, treat to a level that reduces the risk to an acceptable level.

Standard SA-3. Maintain roads, culverts and streams to avoid unnatural flooding in RNAs.

Standard SA-4. Prevent invasive species introduction in RNA.

Standard SA-5. Prevent unauthorized entry into the areas for activities such as grazing, OHV, tree cutting, hunting, etc.

Standards SA-6. Create a management plan for each SIA that includes:

- A baseline set of data for the area including vegetation, wildlife, streams, and geology;
- Management practices designed to meet and enhance the target features of the SIA;
- A monitoring plan for target and key resources in the area; and
- Annual or periodic process for reviewing monitoring and revising the management plan to ensure that the SIA values are being maintained.

Standard SA-7. Protect SIAs against illegal activities that include:

- Geological (including paleontology) – cave disturbance, vandalism, collecting
- Botanical – invasive species, grazing, timber management, fire, collecting
- Scenic – excessive noise, litter, clearcuts, fire
- Zoological – nest and den disturbance, loss of corridors, invasive species, fire
- Cultural - Cultural resources are especially vulnerable to disturbance; once disturbed or damaged, the information lost is irreplaceable. Vandalism of cultural resources is a major concern.

Standard SA-8. Maintain safe access to SIAs.

Standard SA-9. Provide adequate facilities for SIAs.

Standard SA-10. Provide educational materials, e.g., maps and brochures, at SIAs and district offices; work with special interest groups and supporters to develop materials

Standard SA-11. Manage botanical, scenic, and cultural SIAs with appropriate use of prescribed and managed fire to enhance and maintain valued and target botanical features.

D. Regionwide Land Allocations

Table IV K-1. Land allocations for special areas.

Land Allocation	General Description	Management Objective
Special Interest Areas (SIA)	Designated by the individual forest.	Defined by the designation.
Research Natural Areas (RNAs)	Designated by agreement among the national forest and research station.	Maintain biological diversity Provide baseline ecological information Support non-manipulative research Encourage research and university natural-history education.

The following factors should be considered when identifying additional RNAs and SIAs:

- Although natural areas need not be large to protect some rare plant species that are limited to specific rare habitats (e.g., tens of acres), setting aside adequate space for ecosystem-level representation generally requires much larger sites (e.g., hundred to thousands of acres), and these are becoming increasingly difficult to find in places where human development is extensive.

- As part of designation efforts, further conceptual development may also be needed to determine the composition of sites that should be included in a complete and resilient network. One option is to build a redundant natural areas network, with multiple representations of each ecosystem along a gradient of ecological stages and conditions. Such a network would allow for natural change to occur on any given site over time, while still maintaining representation of the ecosystem elsewhere in the network.

- The network could also be expanded to include biodiversity "hotspots" such as sites with rare species or those that comprise unique compositions of taxa that are not adequately captured by plant associations. Site redundancy may be especially important given the growing recognition that climate change (natural and anthropogenic) may pose the greatest challenge to long-term management of natural ecosystems (Malcolm et al. 2002).

- However, redundancy alone will not be adequate to protect some sites in the face of environmental change. For example, climate change will likely result in differential shifts in plant and wildlife communities along moisture and elevational gradients as each organism responds uniquely to environmental change (Lovejoy and Hannah 2006).

- The complexity of the establishment process itself and length of time it takes to get a site established can be an impediment to designation. Designating multiple alternative sites during establishment can be useful in preventing such delays.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Complete establishment documentation, including up-to-date legal boundary descriptions, geographic information system maps, establishment reports, existing survey data, and guidebooks for both new and existing sites and establish a central file location accessible to all partners and interested publics (such as an interagency website).

- Prepare an overlay of existing other specific designated areas of forest preservation (wilderness, wild and scenic river, roadless areas, important bird areas, etc.) with RNAs and SIAs and specify additional designated areas.

- Re-examine areas currently listed in Land Management Plans in light of climate change and increased recreational activities.

- Add remaining missing ecosystems and species listed in current state heritage plans to the natural areas network, beginning with high-priority sites.

- Include proposed alternative sites, if available, when establishing a new natural area.

- Solicit ideas from the general public, scientific community, and California Indian tribes for additional SIA and RNAs.

- Determine what additional monitoring is required to protect existing SIA and RNA resources.

- Determine SIA and RNA opportunities based on revised system and travel management requirements.

- Determine California Indian Cultural SIA opportunities to establish and conserve culturally important gathering areas for tribal traditions such as basketweaving.

- Examine impacts of proposed utility corridors on existing SIA and RNAs.

- Determine SIA and RNA restoration requirements based on legacy impacts (toxic mining, old growth removal, stream bed and flow alteration, grazing, non-native species introduction).

- Existing RNAs and SIAs should be re-examined in light of property ownership changes and buffer areas established where possible. These buffer areas could later be incorporated as an expansion as the areas recover from past activities (an example is Sugar Pine Point RNA where the surrounding lands were exploited by private landholders but the land is now in the hands of the FS).

- Examine the areas identified as Experimental Forest and reconsider the current designation. It might be wise to reclassify as RNA or SIA and minimize the type of manipulation allowed in those areas. A case in point is the Onion Creek experimental forest. Since there is so little older forest left, and by and large that remaining is off limits to commercial exploitation, there is less need for study of major manipulation of older forest areas. New experimental forests can be established for the previously heavily managed forest areas where studies on fuel treatments and restoration activities could be undertaken.

- Review Audubon's Important Bird Areas for potential inclusion as Special Interest Areas.

- Determine wildlife corridors and what impact these may have on existing SIA and RNAs. Evaluate wildlife corridors (allow for climate change), and nest/den location of existing endangered/threatened/special concern species, while protecting the location of these sensitive areas from wide public exposure.

Recommendations for New Regional Direction or Policy

- Conduct an interagency workshop focused on conceptual development of a complete natural areas network across all Sierran forests.

- Ensure that coordination of Research Natural Areas across forest lines occurs, so that logical boundaries include watersheds, wildlife corridors, and protection of rare species and forest ecosystems.

- Incorporate mandatory state and federal environmental reviews for management in natural areas as part of broader agency planning efforts so that natural areas do not need to be addressed separately.

- Consider revision of SIA and RNA requirements based on the new ecosystem approach to forest management, including consideration of larger areas (500+ acres).

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APPENDICES

APPENDIX A
SPECIES ASSESSMENTS AND CONSERVATION MEASURES

INTRODUCTION

This appendix provides brief conservation assessments for 18 native species occurring on national forests in the Sierra Nevada. The appendix also includes assessments and conservation measures for four introduced aquatic species that can adversely affect native aquatic ecosystems. The conservation measures noted here are intended for use in combination with the recommendations for forest plan revisions or other agency actions identified in the conservation strategy.

Table A-1. Species presented in Appendix A.

Species Group	Common Name	Page in Appendix A
Fish	California golden trout	3
	Eagle Lake rainbow trout	5
	Goose Lake redband trout	7
	Hardhead	9
	Kern brook lamprey	11
	Lahontan cutthroat trout	13
	Mountain sucker	15
	Owens speckled dace.	17
Introduced aquatic	American bullfrog	20
	Bluegill	21
	New Zealand mudsnail	21
	Quagga mussel	22
Amphibians	Mountain yellow-legged frog	25
	Yosemite toad	30
Mammals	Black bear	35
	Pacific fisher	38
	American marten	46
	Wolverine	60
Birds	California spotted owl	68
	Great gray owl	80
	Northern goshawk	87
	Pileated woodpecker	94

Our understanding about the life requirements and habitat needs for many special status species is expanding at a remarkable pace. Because of the research and monitoring being undertaken for key species, we recognize that the species accounts and conservation measures identified below are not static and will change over time. We encourage readers to visit the Sierra Forest Legacy website (www.sierraforestlegacy.org) for updates to these accounts. It is our intention to update the accounts periodically in an effort to capture the best available information to support conservation and management.

We briefly note below species for which we expect additional information to be available in the next 12-18 months (Table A-2).

Table A-2 Species for which research or evaluation is ongoing and results anticipated in the coming 12-18 months.

Species	Expected Research or Synthesis of Information
Sierra Nevada yellow-legged frog *Rana sierrae* and *R. muscosa*	These species are expected to be proposed for federal listing in October 2012; recovery planning is expected to follow listing.
Northern goshawk *Accipiter gentilis*	A technical review of northern goshawk in California is expected to be issued by the US Fish and Wildlife Service in September 2012. Brian Woodbridge is the contact person for the review.
Pacific fisher *Martes pennanti*	The Sierra Nevada Adaptive Management Project, Kings River Fisher Study, and regional monitoring are ongoing. Results from these studies are produced periodically and are expected at least through 2016. The Southern Sierra Nevada Fisher Working Group meets at least twice each year to address fisher concerns.
Pacific marten[1] *Martes caurina*	Research is being undertaken by Katie Moriarty, Keith Slauson, and Bill Zielinski that focuses in the northern Sierra Nevada from Lake Tahoe to the Southern Cascades. Results from research on the Lassen National Forest are expected in late 2013.
Yosemite toad *Bufo canorus*	This species is expected to be proposed for federal listing in October 2012; recovery planning is expected to follow listing.
Forest Service Sensitive Species lists	The Sensitive Species lists are being revised by the Forest Service. Species are being removed and added as a result of this assessment. The new lists are expected to be available in October 2012.

Species accounts and conservation measures are under development for the species listed in Table A-3. These accounts should be available by mid-October, posted at the Sierra Forest Legacy website, and located within the electronic version of this conservation strategy.

Table A-3 Species for which conservation measures will be designed and presented in the electronic version of Appendix A posted on www.sierraforestlegacy.org by the end of October 2012.

Scientific Name	Common Name	Reason for Inclusion
Empidonax traillii	Willow flycatcher	Species at risk
Centrocercus urophasianus	Greater sage grouse	Species at risk
Picoides arcticus	Black-backed woodpecker	Species at risk

[1] Taxonomic review has identified martens west of the Rocky Mountain crest as a separate species (Pacific marten, *Martes caurina*) from those to the east (*Martes americana*) (Dawson, N. G. and Cook, J. A. In press. Behind the genes: Diversification of North American martens (*Martes americana* and *M. caurina*). In: K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk, editors. *Biology and conservation of martens, sables, and fishers: a new synthesis*. Cornell University Press, Ithaca, New York.)

FISH

This section provides species accounts and conservation recommendations for the following fish (Table A-3).

Table A-3. Native fish species with species accounts and conservation recommendations (California Department of Fish and Game 2011, Moyle et al. 2011).

Species	CDFG Status	Moyle et al. 2011 Status	Modoc	Lassen	Plumas	Tahoe	Eldorado	Stanislaus	Inyo	Sierra	Sequoia
California golden trout *Oncorhychus mykiss aguabonita*	SC2	2-Vulnerable									x
Eagle Lake rainbow trout *Oncorhychus mykiss aquilarum*	SC2	2-Vulnerable		x							
Goose Lake redband trout *Oncorhychus mykiss subsp.*	SC3	3-Watch List	x								
Hardhead *Mylopharodon conocephalus*	SC3	3-Watch List	x	x	x	x	x	x		x	x
Kern brook lamprey *Lampetra hubbsi*	SC2	2-Vulnerable								x	x
Kern River rainbow trout *Oncorhychus mykiss gilberti*	SC1	1-Endangered									x
Lahontan Lake tui chub *Siphateles bicolor pectinifer*	SC2	2-Vulnerable				x					
Mountain sucker *Catostomus platyrhynchus*	SC3	3-Watch List			x	x					
Owens speckled dace *Rinichthys osculus. subsp.*	SC1	1-Endangered							x		

California Golden Trout, *Oncorhynchus mykiss aguabonita* (Jordan)

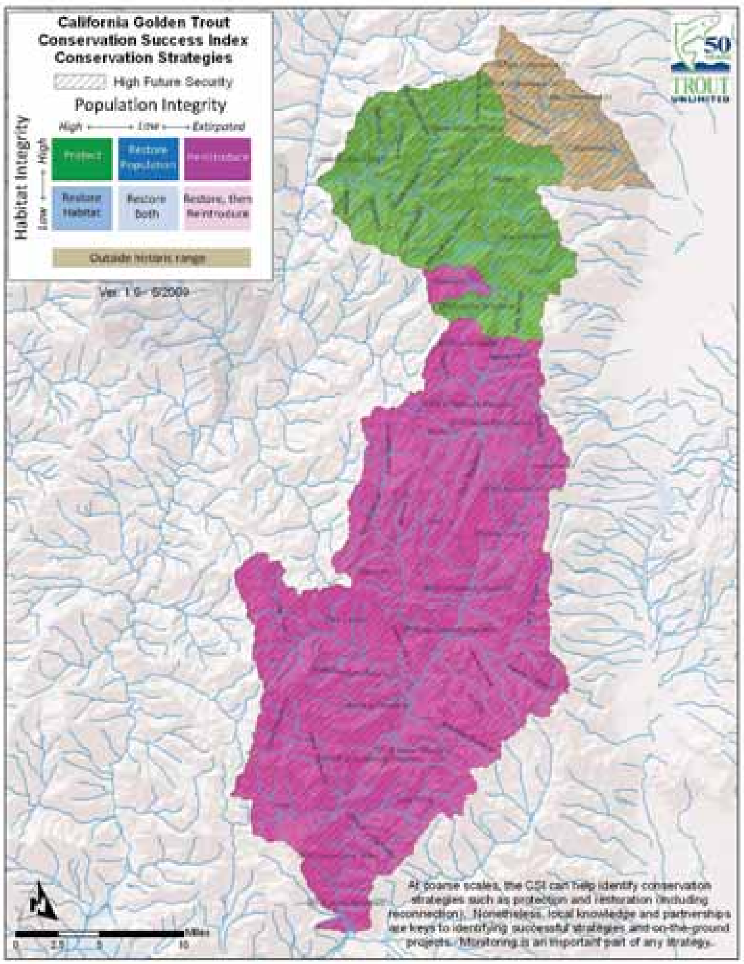
Issue Statement

The California golden trout (*Oncorhynchus mykiss aguabonita*) is endemic to the Kern River drainages in and around the Sequoia National Forest. This small, brilliantly colored fish is the state fish of California and is much sought after by anglers. The California golden trout (CGT) was widely stocked outside of its native range over the last century for sport fishing, but simultaneously non-native trout were stocked throughout their native range resulting in serious predation and introgression issues. Introgression levels range from high (94 percent) in the lower watershed to low (8 percent) in the headwaters. It is estimated there are fewer than 2000 "pure" golden trout left, a decline of at least 95 percent from historical levels.

Area Description

The native range of the California golden trout is limited to the Kern River drainage at the southern end of the Sierra Nevada. Their historical distribution includes South Fork of the Kern River (which flows into Isabella reservoir) and includes the Kern River tributaries Golden Trout Creek and Volcano Creek. By 1914, California golden trout collected from Golden Trout Creek were transported by pack train into numerous Sierran lakes and streams, extending their range by some 160 km. They have been continuously translocated to many waters within the Sierra Nevada and Rocky mountains. As a result, these fish are now found in more than 300 high mountain lakes and 1100 km of streams outside their native range though virtually all populations are introgressed with rainbow trout. A significant portion of CGT native habitat occurs on public lands managed by the Forest Service.

Figure A-1. Summary of current species occurrences and nature of habitat quality. Taken from http://tucsi.tu.org/CaliforniaGolden_General.aspx?Spkey=25.



Desired Condition

CGT should be managed as a high priority species of special concern with an emphasis on retaining genetic integrity and improving and restoring habitat throughout their native range. Barriers to protect genetically pure CGT from rainbow/golden hybrids, rainbow trout, and competitor/predator species should be maintained.

Objectives

- Maintain and enhance habitat throughout the range of CGT.
- Protect unhybridized populations from rainbow trout or introgressed golden/rainbow hybrids.
- Re-introduction of the species into appropriate areas from which it was extirpated.
- Maintain native aquatic foodwebs upon which CGT are dependent.
- Maintain protective barriers to prevent predatory or competitive species from invading CGT habitat.
- Research basic habitat and life history requirements for this species to aid in species conservation and restoration.

Conservation Measures

- Conduct a thorough research review of population genetics
- Implement habitat restoration where needed
- Connect populations where possible
- Eliminate non-native competing trout species

Eagle Lake Rainbow Trout, *Oncorhynchus mykiss aquilarum* (Snyder)

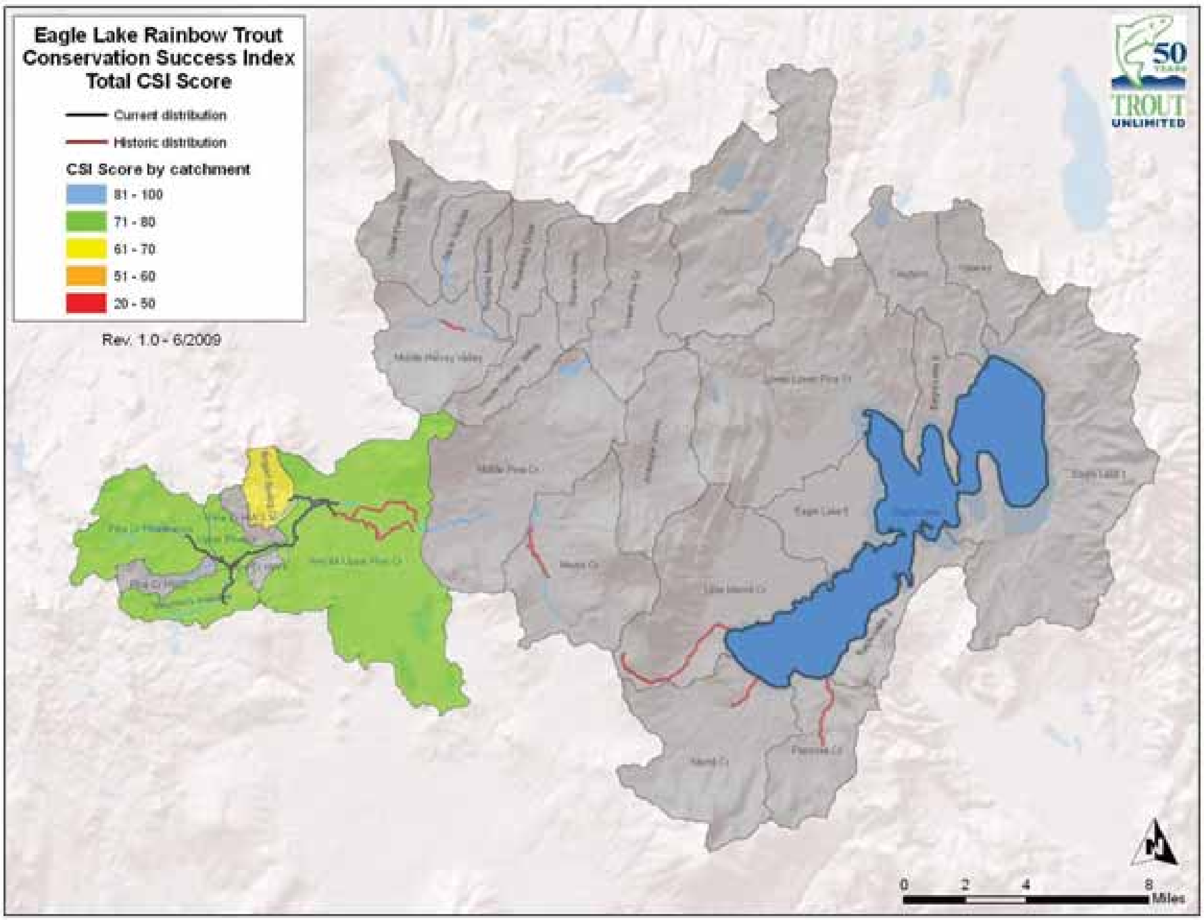
Issue Statement

The Eagle Lake rainbow trout (ELRT) is native to just a single watershed on the Lassen National Forest in northeastern California. Due to overfishing and habitat alteration from logging, railroads, livestock grazing, and water diversions, the ELRT has been essentially entirely hatchery propagated since 1959 when California Department of Fish and Game built an egg taking station on Pine Creek, the main tributary of Eagle Lake, as well as a weir to prevent ELRT from migrating into the river at spawning time. It is thought that a few ELRT would make it over the weir in wet years with the potential for successful spawning, though the numbers were so few and the habitat so degraded that these individuals could not represent a self-sustaining population. To further exacerbate habitat problems in Pine Creek, brook trout (*Salvelinus fontinalis*) were introduced into the upper watershed and are present in extremely high densities, competing with and predating upon ELRT. In 1995, the weir was improved to prevent migration into Pine Creek at any flow level. Considerable efforts have been made by state, local, and federal agencies, as well as stakeholders and resource groups to address the primary habitat problems in Pine Creek. There have been multiple releases of captive broodstock into the upper watershed since 2007 with documented successful spawning. Moyle et al. (2011) indicate that the ELRT is a species of high concern that is vulnerable to extinction in the next 50-100 years. It is essential that a percentage of the ELRT population be allowed to enter Pine Creek and attempt natural spawning on an annual basis.

Area Description

Eagle Lake is located near Susanville, California. It is a terminal alkaline lake that is highly productive and supports a unique fish fauna, though it is not uncommon for low oxygen events to cause fish kills in the winter. Pine Creek, Papoose Creek, and Merrill Creek are the three main tributaries, though Pine Creek is primary among them and likely supported the vast majority of the historical spawning. Pine Creek itself is quite small, only about 50 km long. The upper watershed is spring-fed and there is perennial water, however the lower watershed dries up approximately 6-9 months out of the year. The Eagle Lake watershed is a combination of conifer forested hills and wide, low gradient valleys that would historically have contained wet meadows, but many were drained to support livestock and railroad grades, which drastically changed their hydrology. It is possible that the water table drop from incised eroded stream channels and the abovementioned habitat alterations have created an even shorter season of flow in the lower watershed, further reducing ELRT's ability use their native habitat.

Figure A-2. Map of Eagle Lake Watershed from Trout Unlimited's Conservation Success Index accessed at http://tucsi.tu.org/CSIMaps.aspx?SpKey=22 11/23/2011.



Desired Condition

Eagle Lake Rainbow Trout should be restored as a self-sustaining population on Pine Creek. Continued habitat restoration and careful management of hatchery programs should enable this species to fully reoccupy its historical habitat.

Objectives

- Self-sustaining populations of Eagle Lake rainbow trout given access to Pine Creek
- Assess habitat restoration needs in the Eagle Lake watershed
- Reduce Brook Trout numbers in the upper watershed

Conservation Measures

- Allow spawning adults access to Pine Creek throughout the spawning season
- Further study actual ELRT use of Pine Creek over a variety of water years

- Identify hydrologic requirements for ELRT spawning and rearing, i.e, minimum duration of instream water required for successful spawning, flow, temperature, and habitat use.
- Create a conservation plan for continued restoration and management efforts in the basin

Goose Lake Redband Trout, *Oncorhynchus mykiss ssp.*

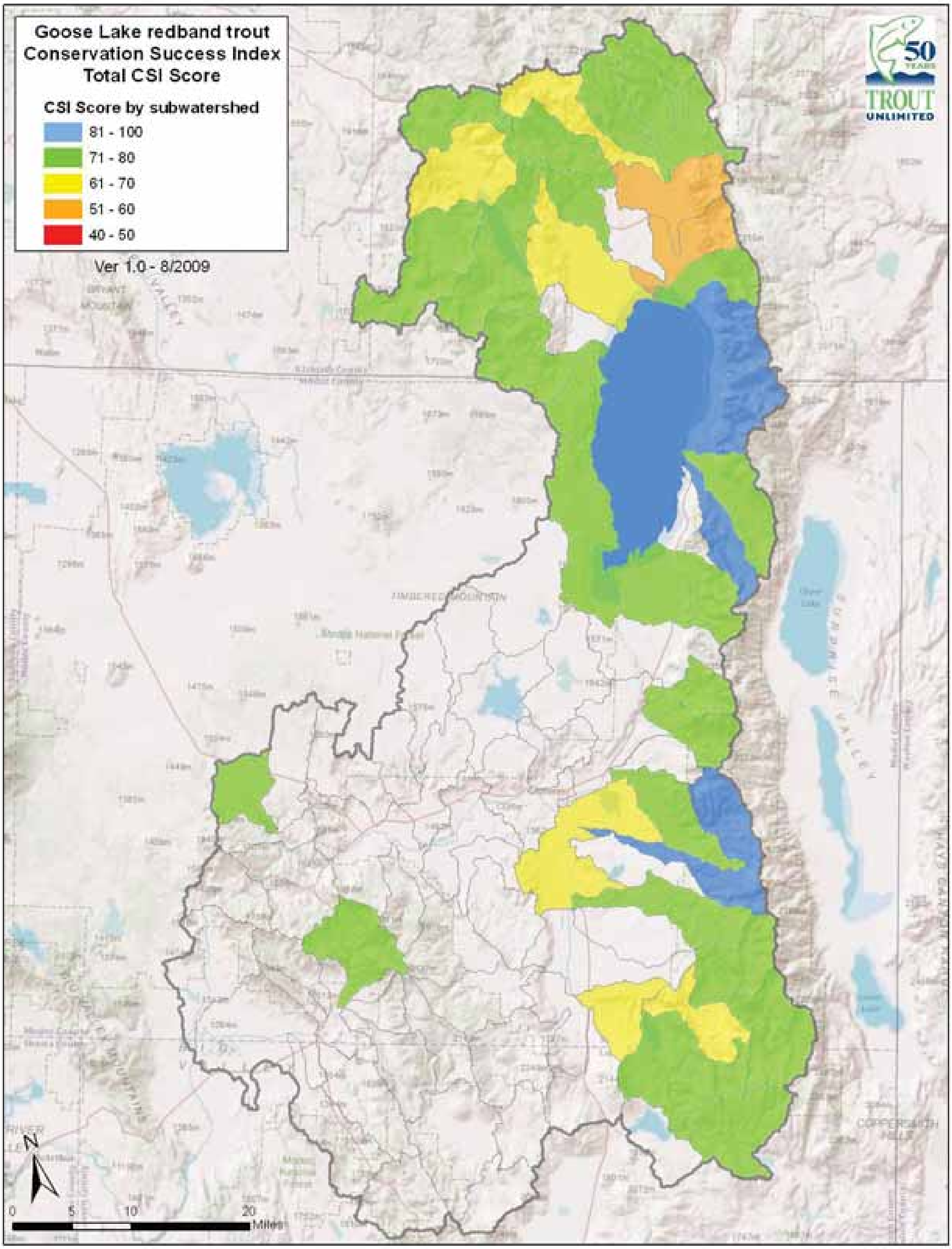
Issue Statement

The Goose Lake redband trout (GLRT) is endemic to Goose Lake and its tributaries which is located on the Modoc National Forest. While it is genetically similar to many of the surrounding isolated populations of redband trout, there is little doubt that the isolation of Goose Lake (a terminal lake basin in all but the most extreme wet years) has created a distinct population segment that should be managed as such. There are two forms of Goose Lake redband, the lake form, which is grows to be much larger and is silvery in color, and the stream form, which mostly occurs higher in the watershed above barriers, remains small, and retains bright coloration and parr marks. Moyle et al. (2011) indicate the GLRT is a species of moderate concern for extinction in the next 100 years. Though mostly anecdotal, it appears that GLRT may have a higher thermal tolerance than other *Oncorhynchus* species. However, climate change impacts in this area may have a profound effect on both stream flows and temperature, making the GLRT vulnerable. Given the small geographic area inhabited, the isolated nature of populations, the occasional drying of Goose Lake, and the likely effects of climate change in the area, GLRT will require careful management and habitat restoration if they are to persist.

Area Description

Goose Lake spans the California/Oregon border in the northeast Corner of California. It is a highly productive alkaline terminal lake basin with only exceedingly rare connections to the Pit River drainage in extremely wet times. Goose Lake supports a highly distinct fish fauna. Willow and Lassen creeks are the primary streams that contain GLRT on the California side. Both have sustained extensive agricultural activities and have problems with stream channel erosion and incision, as well as other water quality issues, though land owners have made considerable efforts in recent years to avoid Endangered Species Act designation. Willow and Lassen creeks both vary between low gradient meadow habitat and steep rocky gorges that are barriers to upstream fish passage. Cold Creek, a tributary of Lassen Creek, is the most likely spawning site for lake form GLRT in California. There have been numerous attempts at meadow restorations in Willow and Lassen creeks with varying results.

Figure A-3. Distribution of Goose Lake redband according to Trout Unlimited's Conservation Success Index. This map includes Warner Mountains populations as well. http://tucsi.tu.org/CSIMaps.aspx?SpKey=27, accessed 11/26/11



Desired Condition

Maintain, protect, and enhance populations of Goose Lake redband throughout their range. Key habitats should be identified and protected, particularly in light of potential climate change effects.

Objectives

- Maintain self-sustaining populations GLRT
- Assess habitat restoration needs in the Goose Lake watershed
- Maintain native fish assemblage in Goose Lake watershed

Conservation Measures

- Maintain free access of GLRT to their spawning streams
- Monitor all GLRT populations
- Identify key limiting factors
- Identify implement key habitat restoration projects in Goose Lake watershed
- Assist land owners in implementing best management practices
- Manage non-native species to limit adverse impacts on GLRT

Hardhead, ***Mylopharodon conocephalus (Baird and Girard)***

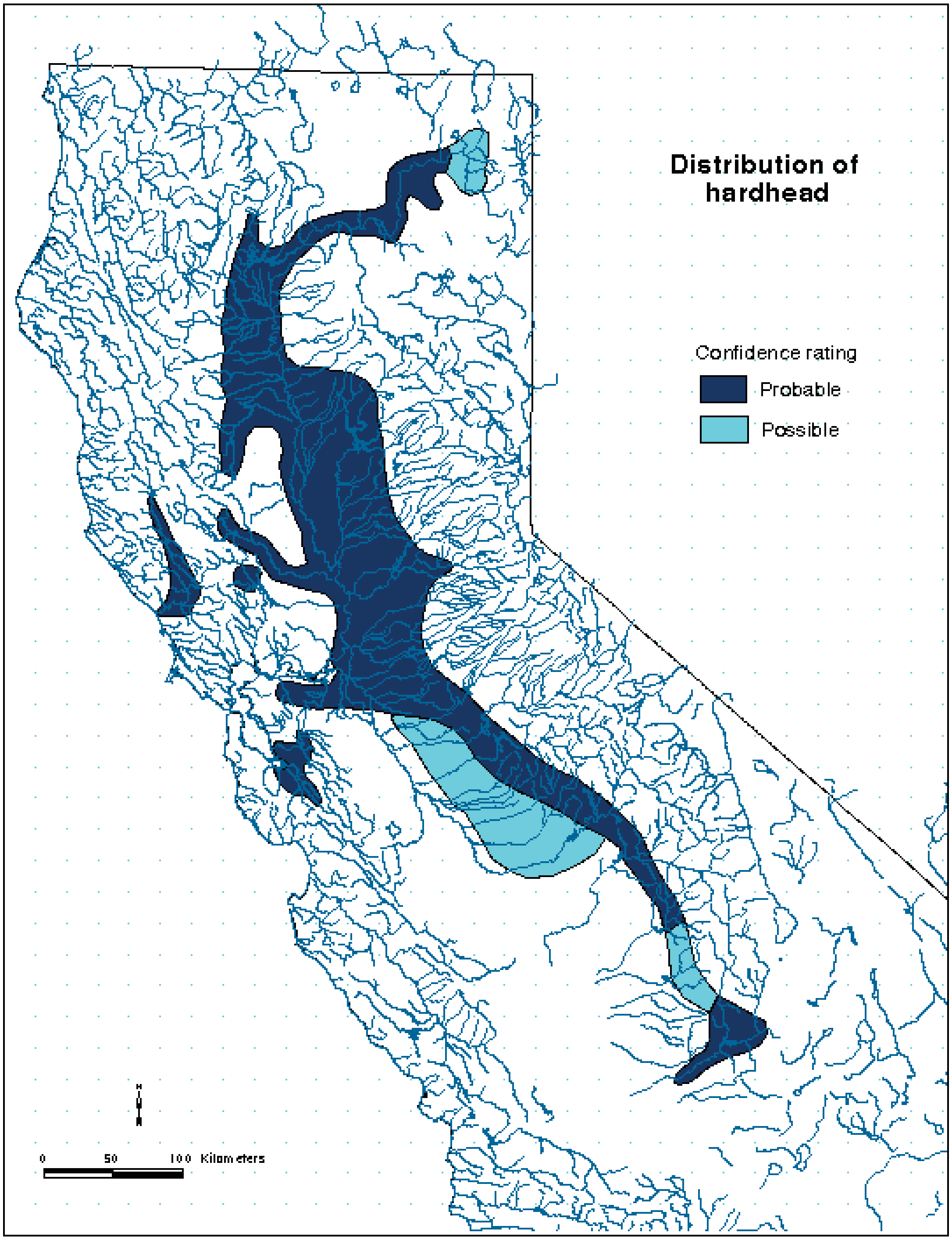
Issue Statement

Hardhead are a large cyprinid (minnow family) native to the waters of the Central Valley and its foothill tributaries. They are considered a species of moderate concern by Moyle et al. (2011). Though there is relatively little information available on their status, trends, and present distribution, most populations are likely small, isolated, and declining in numbers. The hardhead is widely, but patchily distributed in foothill rivers and tributaries and can thrive in reservoirs provided that water levels do not fluctuate widely and they are not highly invaded by non-native predators such as bass and bluegill. There have been notable population crashes of numerous reservoir populations of hardhead throughout their range in recent years. Hardhead are poor swimmers, rendering them frequently incapable of swimming over fish ladders designed for salmonids and unable to reoccupy streams and tributaries they have been extirpated from. While not in immediate jeopardy of extinction, hardhead occupy a unique niche in California's aquatic ecosystems and are not well studied or monitored at the present.

Area Description

Hardhead occupy large and small riverine habitats from the mainstem Sacramento and San Joaquin rivers to an elevation of approximately 1500 meters. They are widely distributed and locally abundant in the foothill tributaries where they tend to inhabit deep pool and run habitats with low velocities. While their occupied habitats are widely altered by large, mid-elevation reservoirs that isolate populations, hardhead are able to use these habitats provided they are not heavily invaded by non-native predatory fishes such as bass. Interestingly, hardhead are absent from the Cosumnes River, one of the few undammed rivers of any size remaining in the foothills, presumably because of the presence of invasive redeye bass (*Micropterus coosae*).

Figure A-4. Hardhead distribution in California according to Moyle and Randall from http://ice.ucdavis.edu/aquadiv/fishcovs/fishmaps.html accessed 11/26/11



Desired Condition

Existing hardhead populations should be conserved throughout their range. All known populations are in need of ongoing monitoring to ensure their continued existence in the face of climate change and continued anthropogenic activities throughout their range as well as the recent crashes of numerous reservoir populations.

Non-native fishes are a continuous threat to the hardhead, particularly aggressive warm water species such as bass, bluegill, and sunfish. Removal of non-native species from key habitats may be necessary to protect the species. Hardhead should be reintroduced to historically occupied areas from which they have been extirpated.

Objectives

- Protect existing populations of hardhead.
- Determine the current actual distribution of hardhead.
- Reconnect extant populations.
- Protect extant populations from non-native species.
- Reintroduce hardhead to formerly occupied areas.

Conservation Measures

- Establish a monitoring program for all populations of hardhead.
- Determine habitat needs and limiting factors for hardhead.
- Complete formal taxonomic and genetic studies on taxonomic status and publish results in a peer-reviewed journal.
- Use basic habitat and life history requirements for this species to aid in species conservation and restoration.

Kern Brook Lamprey, *Lampetra hubbsi* (Vladykov and Kott)

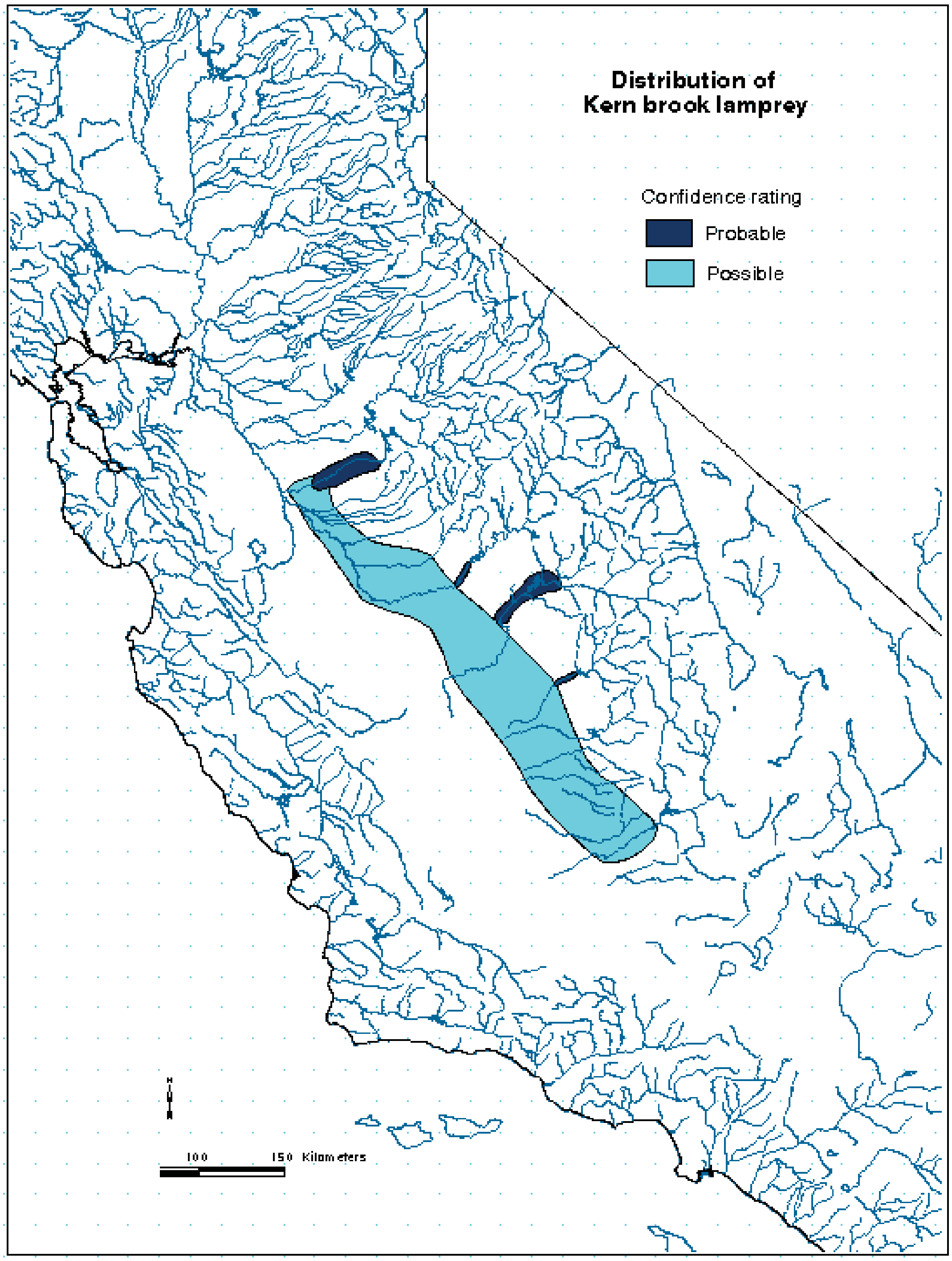
Issue Statement

The Kern brook lamprey (KBL) was first described as a species in 1976. It is a small, non-predatory lamprey endemic to the San Joaquin and Kings rivers. Relatively little is known about its ecology and life history. It appears that its historic range has largely been bisected and isolated by dams and diversions. The effect of large dams, water diversions, channel alteration, and agricultural and urban runoff are presumably profound on this poorly studied species. The habitat requirements of the KBL appear to include backwater habitats where ammocetes (larval lamprey) emerge from the mud to filter food from the water column. Adults require coarser gravel for spawning. They seem to prefer cooler water, rarely exceeding 25˚C indicating that they may historically have been distributed higher in the watersheds. While little is known about this endemic lamprey, all efforts should be made by land managers to conserve existing populations, reconnect populations, and learn the life history requirements of this species to promote better conservation. It is listed as a species of high concern by Moyle et al. (2011) and it is their recommendation that it be treated as a threatened species until more information becomes available on its true status.

Area Description

The Kern brook lamprey is found in the major drainages of the San Joaquin and Kings rivers including the Merced and Kaweah rivers. Most extent populations of KBL are found below the major dams on the Merced, Kaweah, Kings, and San Joaquin rivers, however they have also been found in the Kings River above Pine Flat Reservoir and the San Joaquin River above Millerton Reservoir. The average elevation where KBL are found is 135 meters. Their current patchy distribution throughout the middle San Joaquin system indicates that the population is likely greatly reduced from its historic numbers. The extensive agricultural and urban activities in the region are the most probable influences, though the KBL are so poorly understood that it is hard to determine. Interestingly, the ammocetes appear to thrive in the dark siphons of the Friant-Kern Canal, though due to the lack of appropriate spawning habitat, it seems unlikely that those individuals are successfully contributing to the population.

Figure A-5. Kern brook lamprey distribution in and adjacent to Sierra and Sequoia National Forests from http://ice.ucdavis.edu/aquadiv/fishcovs/fishmaps.html accessed 11/26/11



Desired Condition

The Kern brook lamprey presents a unique conservation opportunity since it is so recently described and so little is known about its historic distribution, ecology, and life history. Determining its habitat requirements is critical to creating a conservation and management plan for the species. Reconnecting extant populations and maintaining habitats that support KBL are essential to their conservation.

Objectives

- Determine the life history requirements of the species.
- Determine the true distribution of KBL.
- Provide KBL refuges, particularly in areas where dams, diversions, agricultural return waters, and channel alteration are highest.
- Reconnect extent populations.
- Identify limiting factors to the species and reduce adverse impacts.
- Explore the possibility of reintroductions of KBL in their native range.

Conservation Measures

- Establish a monitoring program for all populations of Kern brook lamprey and prevent further loss of any known populations.
- Complete formal taxonomic and genetic studies on taxonomic status and publish results in a peer-reviewed journal.
- Use basic habitat and life history requirements for this species to aid in species conservation and restoration.

Lahontan Cutthroat Trout, *Oncorhynchus clarki henshawi*

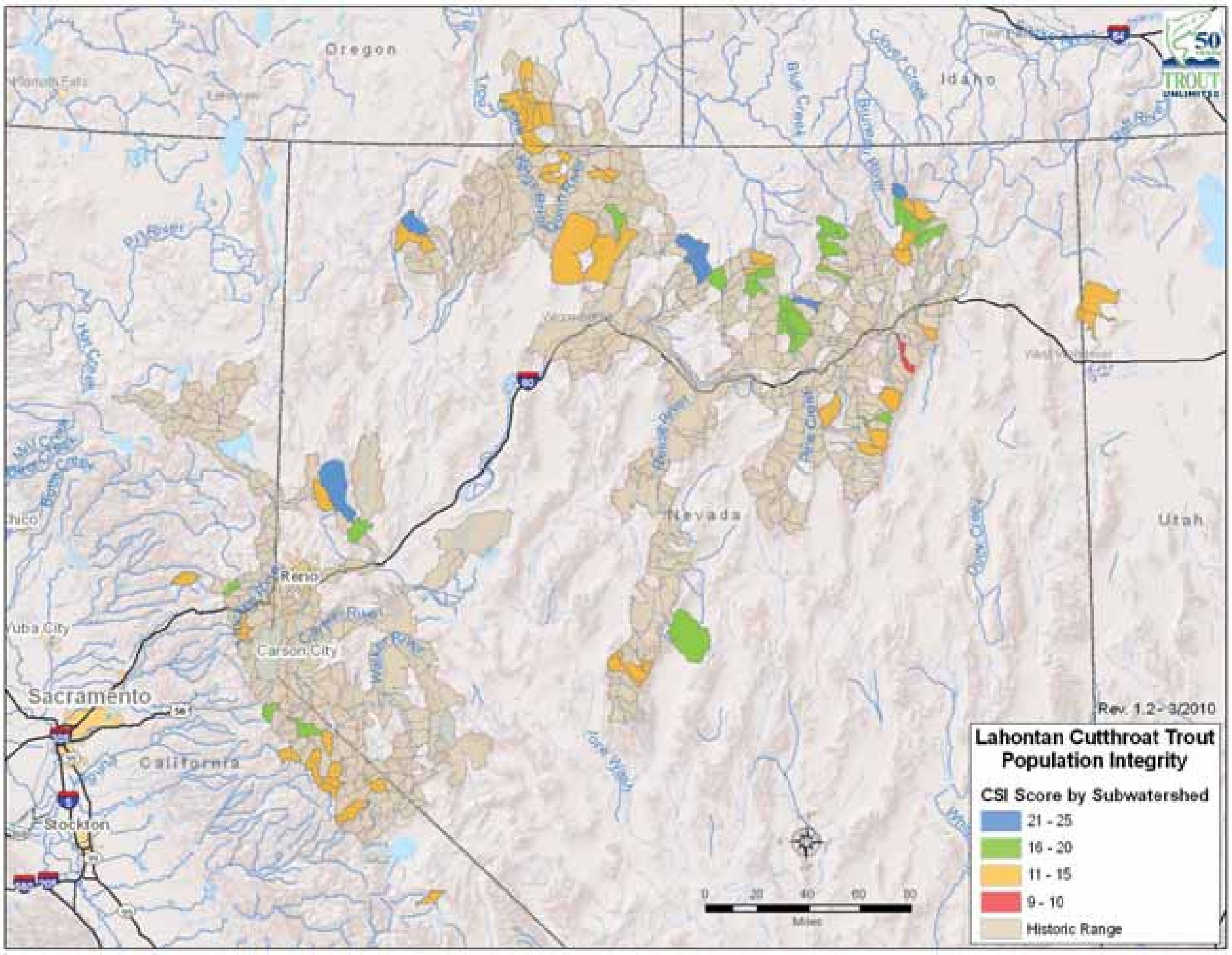
Issue Statement

Lahontan cutthroat trout (LCT) are a cutthroat trout subspecies native to the interior western United States. In 1970, Lahontan cutthroat trout were listed as federally endangered, but were reclassified as threatened in 1975 to facilitate management and allow angling. In a more recent status assessment, Moyle et al. (2008) indicated that the species is vulnerable to extinction in the next 100 years (score of 2). Both a stream form and lake form of LCT exist in California. The lake form has largely been displaced by overharvest and competition from introduced trout species such as mackinaw (*Salvelinus namaycush*) and brown trout (*Salmo trutta*). The stream form has suffered primarily from habitat alteration and predation and competition from non-native species. Lahontan cutthroat readily hybridize with the ubiquitously stocked rainbow trout (*Oncorhynchus mykiss*), which has been a major issue for their conservation and management throughout their range. Additionally, channel alteration, diversions, logging activities, and livestock grazing have all had profound effects on LCT habitat.

Area Description

Lahontan cutthroat trout are patchily distributed across the Lahontan system within eastern California and includes the Truckee River, Lake Tahoe Basin, Honey Lake, Eagle Lake, Walker River, and the Carson-Humboldt. They inhabit waters ranging from tiny alpine creeks to large, low gradient rivers in the Great Basin. The lake form lived in both alkaline terminal lakes such as Walker and Pyramid Lake as well as more oligotrophic alpine lakes such as Lake Tahoe and Independence Lake. Currently, LCT exist in about 11 percent of their historic riverine habitat and approximately 0.4 percent of their historic lacustrine habitat. A significant portion of LCT habitat occurs on public lands managed by the U.S. Bureau of Reclamation and U.S. Forest Service.

FigureA-6. Historic and current distribution of Lahontan cutthroat trout from the Trout Unlimited Conservation Success Index (CSI) accessed at: http://www.tu.org/science/conservation-success-index



Desired Condition

Lahontan cutthroat trout populations in California should be managed for adequate habitat condition and genetic integrity throughout their existing range and reintroduced into formerly occupied areas wherever possible.

Objectives

- Protect existing populations of LCT
- Reconnect extant populations
- Protect extant populations from non-native species
- Reintroduce LCT to formerly occupied areas
- Restore self-sustaining wild populations of both stream and lake type LCT
- Determine likely effects of climate change to LCT populations

Conservation Measures

- Continue monitoring program for all populations of LCT
- Maintain genetic integrity of broodstock and wild populations
- Eradicate non-native competitors and predators from LCT occupied streams
- Monitor and protect LCT habitat from anthropogenic impacts
- Identify key areas for restoration and reintroduction based on potential LCT carrying capacity and habitat value

Mountain Sucker, *Catostomus platyrhynchus* (Cope)

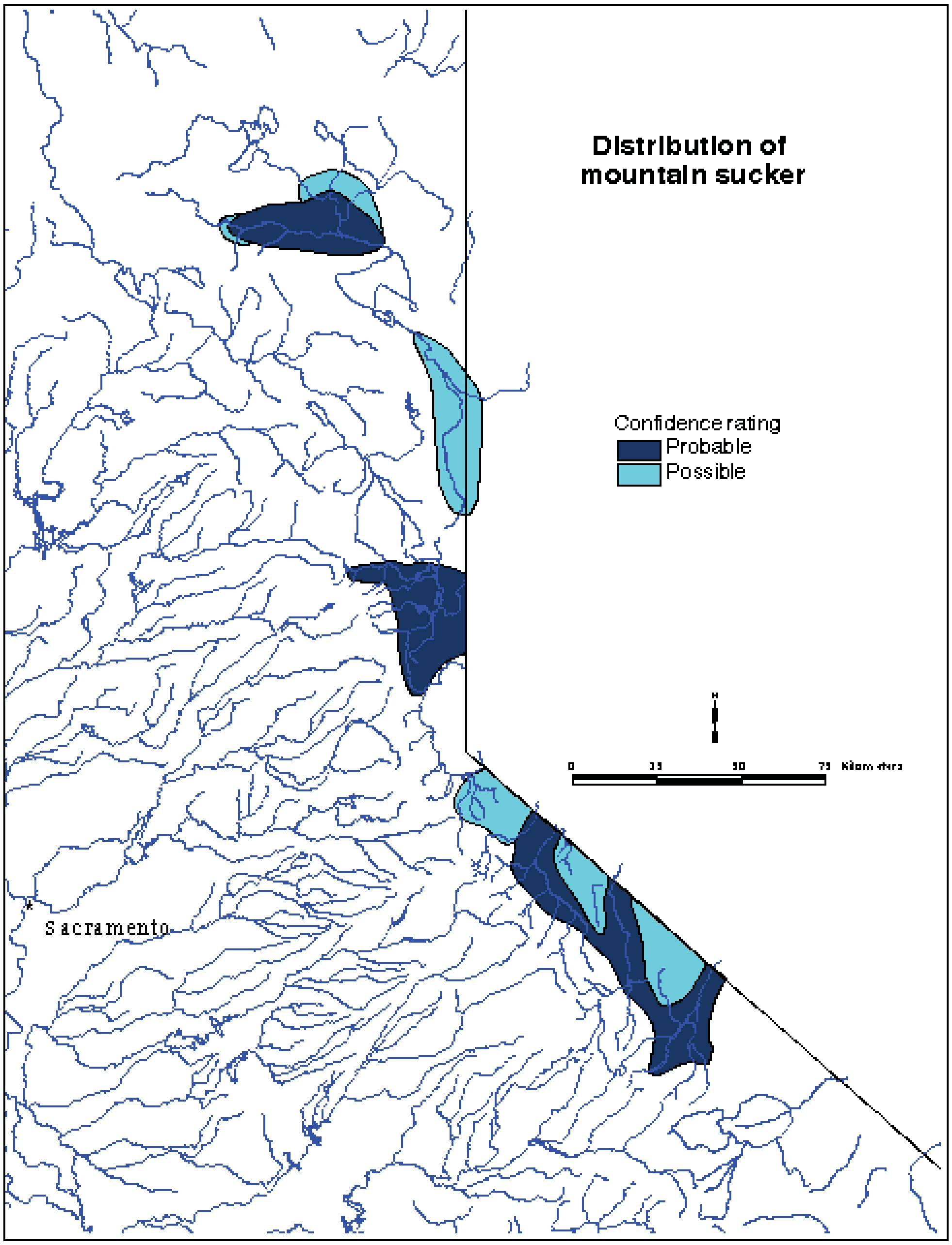
Issue Statement

The mountain sucker is a stream adapted sucker that is originally native only to the Lahontan drainage in California, but was introduced into a tributary of the north fork of the Feather River, presumably through irrigation ditches. Mountain suckers prefer the lower reaches of perennial streams and are in decline throughout their range in California, largely as a result of their inability to persist in reservoirs. The Lahontan basin (including the Feather River population) is likely a distinct taxon due to long geographic separation from other populations, though this has not been examined closely. The mountain sucker is listed as a species of moderate concern by Moyle et al. (2011), though surveys indicate their numbers and distributions are in decline and most populations are isolated from one another. The abundant translocated population in Red Clover Creek in Plumas National Forest represents an opportunity to conserve a species that is in decline in its native range in a nearby system.

Area Description

Mountain suckers inhabit many of the Lahontan drainages in the eastern Sierra, including Honey Lake area, the Susan River, and the Truckee, Carson and Walker rivers. The preferred habitat of mountain suckers is shallow, perennial streams, particularly the lower reaches which are frequently inundated by reservoirs. Low gradient meadow streams are particularly well liked by mountain suckers, which are fairly tolerant of water quality. At Red Clover Creek (site of a translocated population in the Plumas National Forest) a broad meadow system is bisected by a historically highly degraded stream channel that has been the site of large scale meadow restoration efforts by the Plumas Corp. This makes it an especially important system to monitor due to the locally abundant population of mountain suckers and the large-scale habitat changes under way at Red Clover Creek.

Figure A-7. Current and historical mountain sucker distribution in the California.
http://ice.ucdavis.edu/aquadiv/fishcovs/fishmaps.html Accessed 11/26/11



Desired Condition

Mountain suckers should be conserved in occupied streams with ongoing population monitoring, especially in streams where they were historically abundant and have suffered recent population declines (i.e. Sagehen Creek since the construction of Stampede Reservoir). Also of interest is the taxonomic status of the Lahontan populations vs. Rocky Mountains and beyond.

Objectives

- Protect existing populations of Mountain sucker throughout their native habitat.
- Study and monitor the translocated population at Red Clover Creek as an example of how mountain suckers respond to meadow restoration activities.
- Identify and protect key mountain sucker habitat.
- Examine the potential for introgression with Tahoe sucker in concurrent ranges.

Conservation Measures

- Establish an ongoing monitoring program for all populations of mountain sucker.
- Identify areas of introgression with Tahoe sucker.
- Identify current distribution and population trends, particularly in light of climate change.

Owens speckled dace*, Rhinichthys osculus ssp.*

Issue Statement

The Owens speckled dace (OSD) is a speckled dace subspecies native to the Owens River drainages in the eastern Sierra Nevada of California. Its current distribution is limited to a handful of isolated populations in the East Fork of the Owens River near Benton and a number of irrigation ditches in the Bishop area. The most complete recent survey of aquatic habitats in the Owens Valley indicates that OSD have been extirpated from the vast majority of their range and are currently only found in approximately nine locations. While not formally listed under either state or federal endangered species laws, the OSD is certainly highly susceptible to extinction in the next 50-100 years based primarily on habitat alteration, water diversions, recreational use of the springs they inhabit, and introduction of a number of non-native species that either predate upon or compete with speckled dace.

Area Description

Speckled dace are considered the most widely distributed fish species in the western United States. However, most populations are effectively isolated from each other which results in significant morphological and genetic differences between populations. The OSD are most closely related to the Amargosa River speckled dace in Death Valley which would have had occasional connection to the Owens Valley through Pleistocene Lake Manley. The OSD inhabit small streams and hot spring complexes feeding on tiny insects and algae. They are generally found in water temperatures less than 29˚C. The Owens Valley runs roughly north/south between the east side of the Sierra Nevada and the west side of the White Mountains. It is a snowmelt fed system with many geothermal and cold water spring systems as well. Historic surveys of the Owens Valley indicated that OSD occupied nearly all small springs and creeks in the Owens Valley. Current distribution is limited to just nine sites in the Owens Basin representing 7 separate populations. The population in Long Valley at Whitmore Hot Springs in now recognized as a separate taxon. There are five populations in the northern Owens Valley at North McNally Ditch, North Fork Bishop Creek, an irrigation ditch in north Bishop, Lower Horton Creek, and Lower Pine and Rock creeks, and a single small population remaining in the East Fork Owens River drainage at Lower Marble Creek near Benton.

Figure A-8. Owens speckled dace distribution in the Owens River Valley from the 1995 Department of Fish and Game publication "Fish Species of Special Concern in California, Second Edition," by P. B. Moyle, R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. Accessed 11/26/11

Desired Condition

Owens speckled dace should be managed as a species of special concern with an emphasis on protecting remaining populations and their habitat, as well as preventing further population losses due to diversions, non-native species introductions, and recreational use of warm springs. The current abundance and distribution of OSD indicates that protection under the Endangered Species Act is warranted.

Objectives

The most critical needs for Owens speckled dace according to Moyle et al. (2011) include:

- Provide formal protection of existing habitat, including creating special refuges in irrigated agricultural areas.
- Eliminate non-native fishes from springs historically occupied by speckled dace and reintroduce dace from local brood stock.
- Establish Owens speckled dace at additional sites in the Benton and Northern Owens Valley region.

Conservation Measures

- Establish an annual monitoring program for all populations directed towards early detection and mitigation of habitat changes and to the establishment of non-native fishes.
- Complete formal taxonomic and genetic studies to determine taxonomic status.
- Research basic habitat and life history requirements for this species to aid in species conservation and restoration.

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INTRODUCED AQUATIC SPECIES

The following introduced aquatic species are included here because of the adverse impacts they have had on aquatic systems and native fish and amphibians.

American Bullfrog, *Lithobates catesbeianus*

Issue Statement

The American bullfrog, *Lithobates catesbeianus*, native to the eastern United States, has become a widespread global invader. As the largest frog found in the U.S., they are exceptionally adaptable and negatively impact native ecosystems through competition, predation, and introduction of disease. They were first introduced into California in 1898 to satisfy the market for frog's legs, were common in the pet trade, and have become naturalized throughout much of the available aquatic habitat in California to the detriment of native frogs, birds, fishes, and other species.

Species ecology

- They are voracious predators.
- Bullfrogs have been found to be carriers for the fungal disease *Chytridiomycosis*, which is responsible for devastating amphibian populations globally, though they appear to have little susceptibility to the disease themselves.
- Bullfrogs are highly fecund.
- Bullfrogs can migrate large distances.

Habitat preferences

- Warm, permanent bodies of water including lakes and streams, agricultural ponds.
- Bullfrogs are generally found below 5,000 feet elevation in California, though their range may expand with climate change.
- Tadpoles require anywhere from 3 months to over a year to transform, depending on temperature.

Methods of spread

- Pet trade
- Food trade (widely available in Asian markets)
- Bait buckets

Means of control

- Removal of adults
- Draining ponds to kill tadpoles

Control Measures

- Remove bullfrogs from habitats where they negatively affect species of concern.
- Control existing populations and prevent further spread.
- Monitor existing populations and vulnerable habitats regularly.
- Take measures to eradicate bullfrogs where feasible.

Bluegill, *Lepomis macrochirus*

Issue Statement

Bluegill are native to the eastern United States. They have been introduced as sport fish in many bodies of water where they compete with native fishes for habitat and food. They become prolific and are highly aggressive in establishing and defending territories. They were introduced to Lake Tahoe in the 1970s, presumably by anglers, and along with Largemouth bass, threaten what remains of native fisheries. The concurrent introduction and spread of the aquatic invasive weed, Eurasian watermilfoil, has likely facilitated the success of bluegill in Lake Tahoe by providing cover. Typically, bluegill prefer water 60-80˚F, but populations continue to grow in Tahoe and its tributaries indicating both ecological plasticity and a potential range expansion associated with climate change.

Species ecology

- Bluegill are a member of the family Centrarchidae, the sunfishes, which typically prefer warm waters
- Generalist carnivores on mollusks and small fishes
- Aggressively defends territories and nests

Habitat preferences

- Slow to moderate flow
- Warm waters
- Prefers lots of cover, i.e., downed wood, aquatic macrophytes, undercut banks

Method of spread

- Anglers

Means of control

- Electrofishing
- Remove fishing bag limits to encourage anglers
- Chemical treatments (undesirable option due to killing non-target species)

Control Measures

- Control and reduce existing Bluegill populations.
- Prevent of further spread.
- Prohibit intentional stocking of Bluegill in sensitive habitats or areas where they can escape into the wild.

New Zealand Mudsnail, *Potamopyrgus antipodarum*

Issue Statement

The New Zealand mudsnail was first documented in North America on the Snake River in Idaho in 1987. Since that time is has spread throughout the western United States and the Great Lakes region. In California, it is widespread through the Central Valley rivers and their tributaries, the eastern Sierra Nevada. The snails tolerate heavy siltation (e.g., Colorado River) as well as cold, clear alpine streams (e.g., the eastern Sierra). The snail thrives in eutrophic and disturbed systems with heavy algae growth and competes with native invertebrates for food. New Zealand mudsnails can reach densities of 300,000 individuals per square meter under favorable conditions, which can profoundly alter nutrient cycling and primary production in a system. This puts them at a competitive advantage and can reduce the availability of food for native invertebrates and fishes. Further, they can pass through the gut of a fish alive and intact, which means they are a) not nutritionally usable as fish food, and b) able to migrate using fish as a vector. Their sheer densities make them likely ecosystem engineers.

Species ecology

- 95 percent of New Zealand mudsnails are parthenogenic females
- All populations of mudsnails in the United States are clonal females
- The can tolerate a wide range of temperatures and salinities
- New Zealand mudsnails are grazers on algae, diatoms, and other plant material

Habitat preferences

- Any water less than 50m deep is susceptible to mudsnail invasions

Method of spread

- Boat bottoms
- Ballast water
- Fishing equipment
- Waders

Means of control

- Prevent new introductions.
- Potential for biocontrol with trematodes, but not currently used.
- In hatchery situations, CO_2 treatments have proven effective at removing mudsnails.
- Actively clean all fishing gear, boats, bilge water, live wells, and other equipment that may harbor mudsnails.
- Educate the public to recognize NZ mudsnails and take appropriate measures to control spread.

Control Measures

- No new introductions of NZ mudsnails in the Sierra Nevada.
- Control and reduce existing populations.
- Educate the public to recognize NZ mudsnails and take appropriate measures to control spread.

Quagga Mussels, *Dreissena rostriformis bugensis*

Issue Statement

Quagga mussels, a close relative of the zebra mussel, *D. polymorpha*, were first brought to the U.S. in ballast water from shipping vessels traveling from Europe to the Great Lakes. It followed on the heels of the zebra mussel invasion and has very similar ecology and life history attributes. The quagga mussel causes profound changes to the habitats it invades as well as causing serious economic impacts. Quagga mussels are currently found in numerous southern California reservoirs as well as reservoirs on the Colorado River, and in Nevada. With known populations so close to the Sierra Nevada the potential for future introductions is high.

Species ecology

Quagga and zebra mussels are exceptional water filterers, and they impact ecosystems by filtering out significant amounts of plankton and fine particles from the water. This negatively affects zooplankton, which feed on plankton, as well as larval fishes and other species that use both plankton and zooplankton for food. A secondary impact from quagga mussels is the waste they eliminate, called pseudofeces, which settles around the colony, fouling the bottom, causing a drop in pH, and producing toxic byproducts. Additionally, quagga mussels colonize both hard and soft substrates very quickly which can cause severe economic problems with shipping, water intake and outlet pipes, waste water treatment plants, as well as impacting beaches, boats, and docks.

Habitat preferences

- Opportunistic on both hard and soft substrates.
- Prefers cold water.
- Can be found at the surface or depths of up to 130m.

Method of spread

- Most easily spread at larval stage in ballast or bilge water on ships and recreational vessels.
- Capable of spreading through canals and locks.

Means of control

- Prevent spread.
- Chemical treatments have had limited application due to fears of killing non-target aquatic species.
- Oxygen deprivation, exposure and desiccation, radiation, manual scraping, high-pressure jetting (including with high temperature water), mechanical filtration to kill individuals.
- Molluscicides, ozone, antifouling coatings, electric currents, and sonic vibration can be used to control mussels, but have detrimental collateral impacts that may not be sustainable.
- Current research on biocontrol with a bacterium, *Pseudomonas fluorescens.*

Control Measures

- Prevent further spread of quagga mussels.
- Contain and reduce existing populations.
- Educate the public about the problem and continue boat checkpoints to prevent introduction into key habitats such as Lake Tahoe.
- Develop effective control methods.

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AMPHIBIANS

This section provides species accounts and conservation recommendations for the following amphibians (Table A-4).

Table A-4. Native amphibians with species accounts and conservation recommendations in this section (USDA Forest Service 2001, USDA Forest Service 2007).

Scientific Name	Common Name	Status
Rana sierrae and R. muscosa	Mountain yellow-legged frog complex	FWBP, FSS, CSSC
Bufo canorus	Yosemite toad	FC, FSS, CSSC

Mountain Yellow-Legged Frog Complex (*Rana sierrae* and *R. muscosa*)

Issue Statement

The mountain yellow-legged frog is a species complex made up of two species (Vredenburg et al. 2007), the Sierra Nevada mountain yellow-legged frog (*Rana sierrae*) and the southern mountain yellow-legged frog (*Rana muscosa*). Historically, the mountain yellow-legged frog was described as extremely abundant (Grinnell and Storer 1924; Mullally and Cunningham 1956). Today both species are critically at risk of extinction. Comparing historical versus current occupancy for all verified localities, based on museum specimens, Vredenburg et al. (2007) determined that *Rana sierrae* and *Rana muscosa* are now absent from more than 92 percent of historic localities in the Sierra Nevada. Using additional historical records of occupied localities, the U.S. Fish and Wildlife Service concluded in 2011 that 76 percent of historical populations of mountain yellow-legged frog have been extirpated, 54 percent of populations that were extant in 1995 are currently extirpated, and remaining populations have undergone a 19 percent decline in abundance since 1995 (USFWS 2011).

The primary threats to the survival of this amphibian are predation by non-native trout on mountain yellow-legged tadpoles and adults, and infection by the chytrid fungus (*Batrachochytrium dendrobatidi)* that is causing amphibian declines world wide at this time. Other sources of threats which can further reduce viability include wildland fires, fire suppression activities, airborne contaminants including toxins from pesticides and herbicides, climate change, livestock impacts, water developments, and off-highway vehicle (OHV) and other types of recreation (US FWS 2011).

Distribution and Ecology

Rana sierrae is endemic to the Sierra Nevada of California and adjacent Nevada. In the north, its range extends from the Feather River in Butte and Plumas Counties, south to the Monarch Divide and Cirque Crest (Fresno County), and to Independence Creek in Inyo County east of the Sierra Nevada crest. Populations in Nevada consist only on the east and north-east sides of Lake Tahoe in the Carson Range and vicinity. Within the Sierra Nevada, the range of *R. muscosa* extends from the Monarch Divide and Cirque Crest to Taylor and Dunlap Meadows in Tulare County. An isolated population also occurred on Breckenridge Mountain (Kern County). Today, most populations of mountain yellow-legged frog are in Sequoia, Kings Canyon, and Yosemite National Parks (Knapp and Matthews 2000a). In southern California, *R. muscosa* is now restricted to fewer than 10 sites in the San Gabriel and San Jacinto Mountains that collectively harbor fewer than 100 adult frogs (Jennings and

Hayes 1994). In this conservation strategy, we will limit our discussion to those frogs found within the Sierra Nevada.[2]

In the Sierra Nevada the elevation range occupied by both species was between 1400 meters and 3690 meters. The species is usually associated with montane riparian habitats in lodgepole pine, yellow pine, sugar pine, white fir, whitebark pine, and wet meadow vegetation types. Habitat of the mountain yellow-legged frog consists of glaciated lakes, ponds, tarns, springs, and streams in the Sierra Nevada. The adaptations that allow them to live at these high elevations and cold temperatures have made them highly vulnerable to introduced fish species.

Mountain yellow legged frogs are moderately sized ranids ranging between 45-90 mm from snout to vent. All stages of the mountain yellow-legged frog are aquatic. Tadpoles range in size up to 90 mm total length. Frogs spend 8-9 months overwintering under ice. The adults emerge soon after snowmelt in the spring, and breed soon after. Adults lay a single egg mass of 10 to 100 eggs, which hatch in approximately 16-21 days (Vrendenberg 2005 in FWS 2011). Tadpoles typically require 2-3 years (1-4) to metamorphose into juvenile frogs. Juvenile frogs require 3-4 years to reach sexual maturity.

Threats

Until the mid-1800s, fish were absent from nearly all high elevation habitats in California (Moyle et al. 1996, Knapp 1996, Moyle 2002). Stocking trout into high elevation lakes became a common practice during the early 1900s (Knapp 1996) and targeted larger, perennial lakes and streams. According to US FWS data, 87 percent of historically fishless lakes that are 10 acres or larger in surface area and 10 feet or deeper currently have introduced trout populations (USFWS 2011). There are abundant scientific studies indicating that predation by non-native trout has decimated the populations of mountain yellow-legged frogs in formerly fish-less mountain lakes and streams (Bradford 1989, Bradford et al. 1993, Bradford et al. 1998, Knapp and Matthews 2000a,b; Knapp et al. 2003, Vredenburg 2004, Knapp et al. 2007).

Recent surveys also have shown an increase in the deadly disease chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis (Bd),* that is decimating amphibian populations worldwide. It is thought to have originated in Africa and Asia, and was first described in 1999. Retroactive examination of museum specimens has demonstrated that *Bd* first appeared in California during the early 1960s. It is now widespread across the state (Padgett-Flohr and Hopkins 2009). Mountain yellow-legged frogs are highly susceptible to the disease and it is now common in populations of mountain yellow-legged frog throughout the Sierra Nevada (Fellers et al. 2001, Knapp and Morgan 2006, Rachowicz et al. 2006). Chytridiomycosis typically causes massive die-offs of adult and juvenile frogs, leading to population extinctions (Rachowicz et al. 2006; Vredenburg et al. 2010). However, despite ongoing *B. dendrobatidis* infections, some mountain yellow-legged frog populations have continued to persist. This is the only real source of hope for the continued existence of this amphibian (Briggs et al. 2005, Briggs et al. 2010). If predatory fish are also removed from their habitats, the amphibian may be able to recover. Nearly all the remaining populations of mountain yellow-legged frog occur on public lands, and studies have demonstrated that in the absence of disease, it is possible to bring these species back to recovery (Knapp et al 2007).

[2] In southern California, *R. muscosa* was known from the Transverse and Peninsular Ranges, including the San Gabriel Mountains (Los Angeles and San Bernardino Counties), San Bernardino Mountains (San Bernardino County), and San Jacinto Mountains (Riverside County). A disjunct population also existed on Mt. Palomar (San Diego County).

The Sierra Nevada Framework Plan provided strategies to reduce all the factors causing a decline in mountain yellow-legged frog populations including the removal of exotic fish from frog habitat, prohibition of pesticides from frog habitat, removing livestock near lakes and pond areas, prohibiting development of new recreation trails that would affect known frog sites, and the identification of Critical Aquatic Refuges to protect sensitive species. The 2004 revisions to the Framework weakened the protections for the mountain yellow-legged frog by failing to maintain grazing restrictions for amphibian species in key habitats. A return to a robust monitoring and restoration program as promoted and required by the original Sierra Nevada Framework is vital to protect the species from disappearing from the Sierra Nevada altogether

In 2003 the U.S. Fish and Wildlife Service (USFWS) determined that the Sierra Nevada population of the mountain yellow-legged frog should be protected under the Endangered Species Act, but that listing the species under the Act is "warranted but precluded" by the agency's backload of priorities and budget constraints.
On September 15, 2010, the California Fish and Game Commission accepted a petition from the Center for Biological Diversity to list all populations of the mountain yellow-legged frog (*Rana muscosa* and *Rana sierrae*) as "endangered" under the California Endangered Species Act. As a result, both species were listed as "candidate" species and will be managed as "endangered" until the U.S. Fish and Wildlife Service releases its proposed rule related to listing under the U.S. Endangered Species Act in October 2012.

Desired Condition

Sierra yellow-legged frogs are well distributed and occupy their historic range in numbers that reflect a stable and increasing population. Essential habitat is well represented across the species' range as follows: in lentic habitats, or glaciated regions with still water, watersheds or sub-watersheds are trout-free and contain a mix of large (more than 1 ha), deep (more than 1 m) lakes, shallow ponds, and wet meadows interconnected with perennial streams. Where lotic habitats predominate, trout-free watersheds (or sub-watersheds) occur with an extensive network of low and moderate gradient perennial stream reaches containing deep pools and other key habitat elements necessary for all life stages (US FWS 2011). Re-introduced populations are resistant to chytridiomycosis and are stable. Populations are managed to maximize resiliency to human-caused and natural stressors.

Objectives

- Maintain and enhance essential habitat throughout the range of mountain yellow-legged frog.
- Identify and reduce stressors, both natural and human-caused, in order to maximize resilience in populations
- Re-introduction of the species into appropriate areas from which it was extirpated.
- Maintain native aquatic foodwebs upon which mountain yellow-legged frog are dependent.

Conservation Measures

- Coordinate with the California Department of Fish and Game and the U.S. Fish and Wildlife Service to implement recovery plan for the species
- Restore fishless habitat for mountain yellow-legged frog
- Implement habitat restoration measures where needed
- Create clusters of interconnected fishless lakes and ponds providing high quality habitat for mountain yellow-legged frogs and that could be naturally recolonized from nearby source populations.
- Eliminate the stocking of lakes harboring self-sustaining trout populations

- Eliminate populations of non-native predatory species
- Re-introduce mountain yellow-legged frog to appropriate areas
- Reduce recreation pressure in known occupied sites
- Prohibit pesticide use in frog habitat

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Yosemite Toad (*Bufo canorus)*

Issue Statement

The Yosemite toad is declining in both population and range throughout the Sierra Nevada, disappearing from over 50 percent of its historic range. In addition, remaining populations appear to be in decline (Sherman and Morton 1993, Drost and Fellers 1996, Davidson et al. 2002).

> Declines, some in seemingly pristine environments, occurred in the eastern Sierra Nevada between the early 1970s and early 1990s (Kagarise Sherman and Morton 1993). The species is still distributed over most of the original range, and many populations have active breeding and recruitment (Shaffer et al. 2000), but several studies indicate that the species has declined in or disappeared from approximately 50-70 percent of the sites or general locations from which recorded (Jennings and Hayes 1994; Drost and Fellers 1996). A USFWS (2000, 2002) review found additional evidence of declines in distribution and abundance (NatureServe 2012)

Recent monitoring results for the period 2002 to 2009 indicate that Yosemite toad was estimated to occur in only 12 percent of the watersheds with known toad presence prior to 1990. In addition, monitoring of two watersheds indicated that "...adult male population abundances were generally less than 20 males and some meadows had very low abundances. Numbers of egg masses were similarly small" (USDA Forest Service 2012).

The cause of decline is uncertain, but activities potentially impacting the Yosemite toad and its habitat include livestock grazing; commercial and recreational pack stock grazing; recreational use of meadows; hiker and stock trail development and use; predation from introduced non-native fish species; herbicide and pesticide applications; pesticide drift from Central Valley agricultural areas; drift of automobile exhaust pollutants; disease as a result of fungal, bacterial, and other parasitic infections; long-term drought and climate change; and, possibly, recent increases in UV radiation (USDA Forest Service 2004).

Distribution and Ecology

The Yosemite toad is endemic to California, specifically a 130-mile long stretch of the Sierra Nevada from the Blue Lakes region north of Ebbetts Pass (Alpine County) south to 3 miles south of Kaiser Pass in the Evolution Lake/Darwin Canyon area (Fresno County) (Jennings and Hayes, 1994).

The Yosemite toad occupies the upper montane to subalpine zone, below the timberline from 5,000 to 11,000 feet of elevation. Yosemite toads are typically associated with high montane and subalpine vegetation in relatively open wet meadows surrounded by forests of lodgepole or whitebark pine. "The Yosemite toad breeds in late spring in areas of shallow water such as wet meadows, margins of ponds and lakes, and slow-moving streams. Breeding usually only lasts 1–2 weeks after which adults typically move to upland areas. Eggs and larvae develop in the shallow water areas and metamorphosis occurs by late summer of the same year. Adults tend to breed in a single site and appear to be highly philopatric, although individuals can move between breeding areas (Liang, pers. obs.). Breeding sites exhibit variation in year-to-year occupancy and some sites are consistently occupied while others are intermittently occupied" (Liang and Stohlgren 2011).

Previous estimates of movement distances by post-breeding toads have been fairly low (20 feet; Mullally 1953), but more recent studies indicate that toads can move significant distances (mean of 275 meters and as much as 1.2 kilometers) into upland forested areas (Martin 2008, Liang 2010). Martin (2008) estimated home range at approximately 8,460 m^2 (2.1 ac), while Liang (2010) estimated mean home range of 27,430 m^2 (6.8 ac), and noted female home range was more than 1-1/2 times larger than males. Yosemite toads seek cover during non-breeding seasons (approximately August to March) in abandoned rodent burrows (Jennings and Hayes 1994) or by moving into adjacent forested areas (CDFG 2005).

Liang and Stohlgren (2011) evaluated habitat conditions at consistently occupied and intermittently occupied sites in the southern Sierra Nevada. Their modeling results indicate that "that the distribution of the entire population was highly predictable, and associated with low slopes, specific vegetation types (wet meadow, alpine-dwarf shrub, montane chaparral, red fir, and subalpine conifer), and warm temperatures. The consistently occupied sites were associated with these same factors, and also highly predictable. However, the intermittently occupied sites were associated with distance to fire perimeter, a slightly different response to vegetation types, distance to timber harvests, and a much broader set of aspect classes." (Liang and Stohlgren 2011). The maximum probability of occurrence was associated with a distance of approximately 300 feet from fire perimeters or timber harvest. Liang (2010) use radio telemetry to follow the movements of toads and examined habitat associations at a fine scale. The study found that "Yosemite toads used terrestrial environments extensively and were found throughout the mixed-conifer forest. Burrows were the most commonly used microsite but other protective cover such as logs, rocks and tree stumps were also used. The locations occupied by Yosemite toads in the terrestrial environment were more open with less canopy and fewer woody species than surrounding areas" (Liang 2010).

Recently published studies of livestock grazing impacts on Yosemite toad found no detectible effects of grazing treatment effect on Yosemite toads or their most preferred habitats within meadows, no benefits from partial meadow fencing, and concluded that toad occupancy and survival are more directly correlated with meadow wetness than the intensity of cattle use (McIlroy et al. 2012, Roche et al. 2012a and 2012b). Primarily this resulted from spatial partitioning within meadows, with cows favoring drier sites for grazing and toads favoring wetter sites.

The studies to date have only tested the effects of altered grazing practices within local patches of meadows (e.g. trampling of toads by cattle), but did not test the larger-scale question of whether meadow alterations by grazing adversely impact toads (Scurlock and Frissell 2012). For example, where long-term grazing has caused or contributed to channel downcutting and water table lowering in meadows, then grazing renders meadows reduce wettedness of meadows, favoring cattle grazing at the direct expense of toad habitat on wetter sites. Contrary to media reports, this does not necessarily mean that cattle do not adversely impact toads; it may mean the impact is manifest at a larger scale and longer time frame, where the cumulative effect of grazing is to desiccate meadows, rendering toad habitats more vulnerable to climate and weather variability (Id.).

It remains unknown whether hydrological functions in degraded meadows can be substantially recovered while sustaining livestock grazing. But the data from these studies suggest a clear tradeoff: with future meadow restoration and hydrologic recovery, either prime grazing habitat will decline, or overlap between toads and cattle could increase as meadow wetness increases and toad populations benefit.

Desired Condition

- Remaining population centers are stabilized and numbers of individuals are increasing.
- The quality and amount of habitat is increasing.
- Existing population centers have expanded into suitable habitat.
- Increase in overall population numbers and reestablishment into historical range

Objectives

- Eliminate impacts and stressors occurring in meadow systems and adjacent upland habitats suitable for Yosemite toad.
- Protect occupied Yosemite toad habitat (areas with standing and slow moving water - wet meadows, lakes, and small ponds, as well as in shallow spring channels, side channels of streams, and sloughs)
- Restore potential habitat.
- Restore and protect suitable Yosemite toad breeding habitat (e.g., edges of meadows, seasonally flooded meadows, slow-flowing shallow spring channels, and runoff streams).
- Maintain upland connections between all known populations to promote genetic diversity.
- Enhance and protect the wettable areas adjacent to and within occupied meadows and ensure that activities around and within such meadows do not contribute to drying, chiseling or compaction of the important habitats.

Conservation Measures

- Eliminate livestock grazing in the entire meadow system for meadows occupied by the Yosemite toad.
- Eliminate commercial and recreational pack stock grazing in occupied Yosemite toad meadows.
- Decommission unnecessary roads or roads that degrade meadow hydrology and function in Yosemite toad habitat and ensure that existing roads or trails do not contribute to habitat degradation.
- Delineate a Yosemite toad land allocation that includes all occupied meadows, logical connecting habitat among meadow, and include habitat that may not be consistently occupied. Use Liang and Stohlgren (2011) and other appropriate suitability models to support the delineation.

Table A-5. Land allocations specific to Yosemite toad conservation.

Land Allocation	General Description	Management Objective
Yosemite Toad (YT)	Habitat around sites with YT including wet meadows with standing water and saturated soils, streams, springs, important upland habitat, and habitat identified as "essential habitat" in the conservation assessment for the Yosemite toad.	Provide habitat conditions to support successful reproduction and persistence. Maintain hydrologic function of meadow system. Limit human uses in areas not currently in excellent condition.

- Design activities in uplands areas that may support Yosemite toad to avoid disrupting habitat and killing toads during times when Yosemite toads are most likely to be migrating.
- Avoid vegetation management activities in the uplands or in meadows that threaten any life stage of Yosemite toad until population centers are stable and increasing.
- Restrict recreational use of meadows (e.g. hiking trails), especially during the breeding season
- Avoid direct application of pesticides within 1,000 feet of Yosemite toad habitat.
- Reduce the use of pesticides in the valleys downwind from the Sierra Nevada and Yosemite toad habitat
- Eliminate exotic fish from toad habitat.
- Convene a multi-agency and stakeholder group to develop a conservation strategy to protect and recover Yosemite toad.
- Undertake research and monitoring to assess the causes of population decline, improve knowledge of habitat us and population dynamics, and support development of additional conservation measures.

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MAMMALS

This section provides species accounts and conservation recommendations for the following mammals (Table A-6).

Table A-6. Native mammals with species accounts and conservation recommendations (USDA Forest Service 2001, USDA Forest Service 2007).

Scientific Name	Common Name	Status
Ursus americanus	Black bear	SAR-M
Martes pennanti	Pacific fisher	FWBP, CC
Martes caurina[3]	Pacific marten	FSS, CSSC, MIS
Gulo gulo	Wolverine	FSS, CT

CT California Threatened Species
CC California Candidate for listing
CSSC California Species of Special Concern
FSS Forest Service, Region 5, Sensitive Species
FWBP Federal "Warranted but Precluded"

[3] Taxonomic review has identified martens west of the Rocky Mountain crest as a separate species (Pacific marten, *Martes caurina*) from those to the east (*Martes americana*) (Dawson, N. G. and Cook, J. A. In press. Behind the genes: Diversification of North American martens (*Martes americana* and *M. caurina*). In: K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk, editors. *Biology and conservation of martens, sables, and fishers: a new synthesis*. Cornell University Press, Ithaca, New York.)

MIS Forest Service, Region 5, Management Indicator Species
SAR Forest Service, Region 5, Species at Risk (L = low vulnerability; M = moderate vulnerability; H = high vulnerability) (USDA Forest Service 2001)

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Black Bear (*Ursus americanus*)

Issue Statement

Black bears are common in California and can be found mostly in mountainous areas over 3,000 feet in elevation. The black bear population has been steadily increasing over the past 25 years and in 2008 there were an estimated 37,518 black bears in California. The California Department of Fish and Game consider the black bear an important component of California's ecosystems and a valuable resource for the people of California (California Department of Fish and Game 2012).

Black bears are very opportunistic eaters and consume a diet that consists of grasses, roots, nut and berries, insects, fish, and mammals (including carrion). They are one of the most adaptable of all large carnivores and will readily use anthropogenic food sources like garbage and pet food (Beckmann and Berger 2003). Black bears will raid trash cans, break into cars and houses, and steal food from campers, which often leads to conflict and can lower human tolerance of the species. Conflict with humans is a critical and growing management issue throughout the species range (Baruch-Mordo et al. 2008), including the Sierra Nevada.

Distribution and Ecology

The Sierra Nevada subpopulation encompasses the Sierra floristic province and extends from Plumas County south to Kern County (California Department of Fish and Game 1998). Black bears inhabit the entire region. Forty percent of the statewide black bear population inhabits the Sierra Nevada but this subpopulation tends to be less dense with between 0.5 and 1.0 bears per square mile (Sitton 1982, Grenfell and Brody 1983, Koch 1983). Over two-thirds of the bear habitat in the Sierra Nevada is administered by the U.S. Forest Service and two large National Parks are located within this region (California Department of Fish and Game 1998).

Black bears occupy a variety of habitats; however, bear populations are densest in forested areas that contain a variety of seral stages. Bears prefer habitats with both vegetative and structural diversity because these environments provide alternate food resources when other foods are in short supply. Food availability for black bears has been strongly correlated to reproductive success in female bears (Jonkel and Cowan 1971, Piekielek and Burton 1975, Rogers 1987). Vegetation and structural diversity not only fosters greater survival of existing bears, but also provide for increased reproduction. Black bears prefer mountainous habitats like montane hardwood, montane chaparral, and mixed conifer forests. They will use other habitat types such as grassland but to a much lesser degree.

Many of the important food plants (e.g., manzanita, oaks) utilized by black bears grow primarily in forest openings. Controlled burns or other management strategies aimed at creating a mosaic of forest openings can be beneficial to black bears by providing abundant food resources in close proximity to cover. Retention and recruitment of snags and woody debris provide den sites and potential food source (colonial insects). Fire suppression resulting in even-aged stands with less diversity of vegetation and ecosystem structure decreases habitat value for black bears (California Department of Fish and Game 1998). Female bears require secure, dry den sites for birthing and raising cubs. Dens have been found in slash piles, under large rocks, and even on open ground, but the most secure and thermally protective den sites are associated with large trees.

Desired Condition

- Quality home ranges and dispersal habitat are distributed across the landscape in a pattern that allows the movement of black bear and thereby facilitates breeding among individuals.
- Large blocks of suitable habitat and core areas within these blocks where bears encounter few humans.
- The natural distribution, abundance, and behavior of the black bear population are restored.
- Human-bear interactions and conflicts are managed and reduced.
- Fragmentation of black bear habitat has been reduced through the closure and obliteration of roads and the net reduction in total road density.
- Quality denning sites exists in adequate quantity across the landscape.
- Formal system of monitoring and research on black bear behavior, habitat selection and use, and human-bear interactions has been established.

Objectives

- Forest ecosystems are managed through the use of controlled and natural fire (let-burn policy) to create a mosaic of openings with adequate vegetative and structural diversity.
- Bear management programs are instituted in the urban-wildland interface to reduce the incidence of human-bear interactions and conflicts.
- Vegetation management (e.g., fuel reduction, forest restoration) projects are designed to maintain adequate denning sites and increase vegetative and structural diversity.
- Forest fragmentation is reduced by closing/decommissioning key roads and reducing overall road density in suitable bear habitat.
- Monitoring of black bear status is undertaken annually and management direction should adapt to data acquired by monitoring efforts.
- Habitat corridors that provide adequate cover and resting areas are maintained to provide movement between suitable black bear habitat patches.
- Black bear management plans will be completed by 2020.

Conservation Measures

- The recommendations in the conservation strategy that address old forest ecosystems, riparian and aquatic ecosystems, fire and a disturbance process, and structural diversity of plant communities conservation are expected to provide direct benefits to the conservation of black bear.

- Ecological restoration projects (e.g., fuel reduction, controlled burning) shall include black bear management strategies such as:
    a. Retaining large snags and woody debris as den sites and potential food sources, and

b. Creating a mosaic of forest openings to provide abundant food resources in close proximity to cover.

- Reduce fire suppression activities outside the wildland-urban interface and promote controlled and natural burns to facilitate vegetation and structural diversity.

- Remove barriers (e.g., roads, human infrastructure and developments) to black bear movement within and between suitable habitats.

- Create large blocks of suitable habitat by removing key un-needed roads and reducing the overall road density to less than 1 mile/miles^2 in high quality habitat (Wildlands CPR 2012).

- Reduce human-bear interaction by increasing public education and outreach, providing bear-safe trash receptacles for homes, and bear-proof containers at public recreation sites.

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Pacific Fisher (*Martes pennanti*)

Issue Statement

> *Now essentially confined to two populations in the southern Sierra Nevada, California, and northern California-southern Oregon; unregulated trapping for furs, predator bounties, and extensive, lethal predator control programs likely impacted fishers for nearly two centuries and were exacerbated by loss and fragmentation of habitat from urban growth and development, forest management activities, and road construction; the remaining two populations are threatened with extirpation due to their small size and isolation. There is substantial information indicating that the interaction of all the factors above may cause the populations of fishers in their west coast range to become significantly at risk of extirpation. (NatureServe 2012)*

It has been estimated that there are less than 300 adult fishers in the southern Sierra Nevada (Spencer et al. 2011). Fishers have declined historically from over-trapping, population isolation due to forest fragmentation, habitat alteration, poisoning, and loss of prey species resulting from rodent and predator control (Lofroth et al. 2010). Zielinski and Mori (2001) identified several possible reasons for the failure of the fisher to reoccupy areas in the Sierra Nevada since initial population decline: (1) insufficient habitat exists for dispersing animals to found new populations, (2) existing populations are too small to provide sufficient numbers of dispersing animals to recolonize the vacant areas, or (3) dispersal habitat is of poor quality, or is interrupted by non-forest land uses and roads, and dispersing animals succumb or are killed during dispersal.

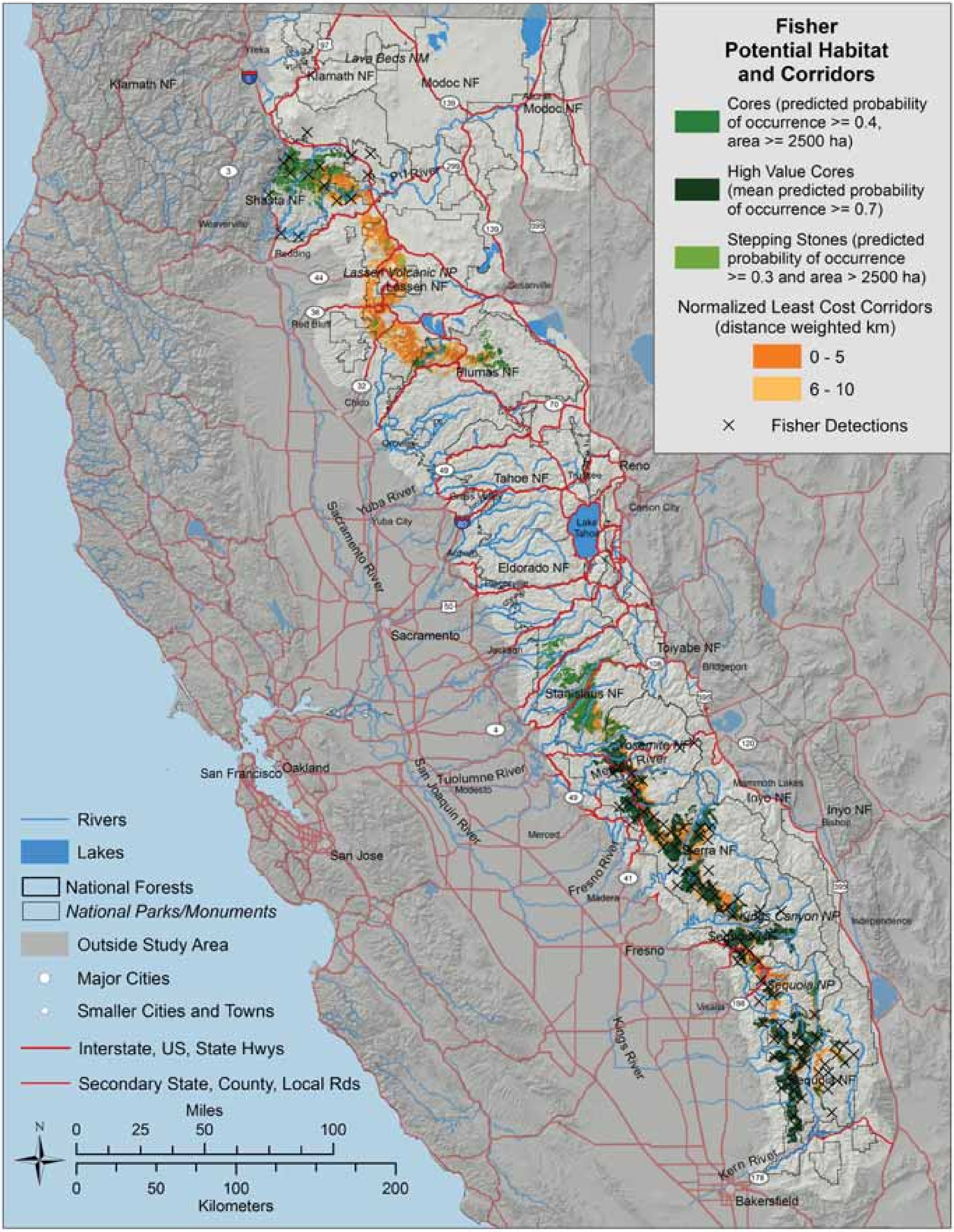
Distribution and Ecology

In eastern California, the fisher historically ranged throughout the Sierra Nevada, from Greenhorn Mountain in northern Kern County northward to the southern Cascades at Mount Shasta (Grinnell et al. 1937). It is considered that they now occur primarily in a continuous band of low to mid-elevation forest on the western slope of the Sierra Nevada, rarely ranging above 7,000 feet. Fisher have rarely been detected north of the Merced River in the last 20 years (California Department of Fish and Game 2010). Recent surveys indicate that fishers appear to occupy less than half the range they did in the early 1900s in California. Currently, there are two remnant populations that are separated by approximately 260 miles (Zielinski et al. 1995), almost four times the species' maximum dispersal distance as reported by York (1996) for fishers in Massachusetts. Failure to detect fishers in the central and northern Sierra Nevada, despite reports of their presence by Grinnell et al. (1937) and reports from the 1960s collected by Schempf and White (1977), suggests that the fisher population in this region has declined, effectively isolating fishers in the southern Sierra Nevada from fishers in northern California. Knaus et al. (2011) found that genetic analysis of the northern California population has been isolated from the population in the Sierra Nevada for more than a thousand years. Although these results indicate that the populations have been separated for a lengthy period of time, it is not known how long fishers have been extirpated from the area between Lassen National Forest and Yosemite National Park, i.e., the "gap" in the Sierra Nevada. The information in Grinnell et al. (1937) and others' incidental sightings suggest that fishers were present in this area during the 20th century.

Fishers are found in low to mid-elevation forests (3,500 to 7,000 feet). Their distribution is limited by elevation and snow depth; they are unlikely to occupy regions where elevation and snow depth act to limit their movements. Fishers select for conifer or conifer-hardwood mixed forests with dense canopy coverage at all spatial scales, and large trees, snags, and downed logs (Powell 1993, USDA Forest Service 2006, Lofroth et al. 2010). Studies in the southern Sierra Nevada (e.g., Mazzoni 2002, Zielinski et al. 2004) showed that a significant, although not large, percentage of home range area was composed of stands of large trees generally greater than 61 cm diameter breast height (dbh) and relatively dense canopy coverage (>50 percent). Fishers are more likely to be detected in larger forested stands (>125 acres), especially stands with high connectivity (Rosenberg and Raphael 1996). In the southern Sierra Nevada, fishers prefer areas with oak, which are used for resting and denning (USDA Forest Service 2006). Powell (1993) suggested that forest type is probably not as important to fishers as the vegetative and structural aspects that lead to abundant prey populations and the reduction of fisher vulnerability to predation (USDI Fish and Wildlife Service 2004). Fisher populations require large forested areas with fairly dense canopy cover that provides productive prey habitat, protection from predators, and snow cover. Trees with cavities and the presence of suitable denning and resting structures appear to be key resources at the microsite scale within these forested areas and generally the largest of such elements are selected for denning or resting (Purcell et al. 2009). Fully functioning ecological processes of decay and disease are required to develop the den and rest structures and microsite characteristics over time. Such characteristics are more prevalent in, but not limited to, older forests (USDA Forest Service 2006).

Based on an evaluation of habitat use, Spencer and Rustigian-Romsos (2012) developed habitat models for fishers in the Sierra Nevada (Figure A-9). This assessment developed models for general use, denning and movement based on habitat associations from the literature (Id.). At the present time, higher quality habitat north of the Merced River is not occupied. “This may be due to the combination of dispersal filters associated with Yosemite Valley (steep slopes, Merced River, heavy traffic) and high mortality in occupied areas south of the Merced River, which probably limits the number of potential dispersers (Spencer et al. 2011, Carroll et al. In Press).” (Id.) Spencer and Rustigian-Romsos found, based on fisher use of areas not reflected as higher probability in the models, that predicted habitat was likely underrepresented in the Sequoia-Kings Canyon National Park and the Kern Plateau and recommended further evaluation of these areas. The map below (Figure A-9) illustrates the distribution of predicted core habitat, high value habitat, and areas important for movement throughout the Sierra Nevada. Additional maps presented in Spencer and Rustigian-Romsos (2012) (and data available from the Conservation Biology Institute) provide a closer view of the arrangement of habitat in the southern sierra Nevada.

Figure A-9. Potential habitat and movement corridors for Pacific fisher (Spencer and Rustigian-Romsos 2012).



Threats

Naney et al. (2012) in an assessment of threats through the West Coast range of Pacific fisher found that the most immediate and challenging threat was their small population size and the isolation of the three West Coast populations. “Small, isolated populations are inherently at higher risk of extirpation owing to stochastic phenomena and uncertainty” (Id.). The assessment concluded that management activities that resulted in loss of important structures for denning and resting, loss of overstory cover, and reduction in recruitment rate of future forest structure threatened the persistence of fishers (Id.). Furthermore, “the relatively narrow distribution of suitable, mid-elevation forests they occupy elevates the potential for populations to be fragmented by fires or management actions” (Spencer and Rustigian-Romsos 2012).

Previous studies have found that forest practices resulting in the conversion of conifer-dominated forest to hardwood-dominated forest may be detrimental to fishers, because of the loss of denser canopy structure (Buck et al. 1994). Likewise, fishers are negatively associated with clearcuts and forested stands significantly edged by clearcuts. Timber harvest can fragment fisher habitat, reduce habitat size, or change the forest structure making it unsustainable for fishers. Logging and development have caused severe loss and fragmentation of old-growth forests. Stand replacing wildfires, as well as management activities designed to prevent such fires by reducing the amount and continuity of forest fuels, all can result in significant reduction in suitable habitat needed to provide for fisher viability.

Recent studies also have begun to evaluate the causes of mortality for fishers in the southern Sierra Nevada. Mortality from predation has been identified as a leading cause of death in the SNAMP (Sweitzer 2011) and Kings River study (Thompson et al. 2011a). Road related losses are also significant in areas, such as the SNAMP study, affected by major highways (Sweitzer 2011). Mortality related to poisoning is an emerging threat to fishers. Recent results from blood samples and post-mortem evaluations of fishers indicate that contamination from anticoagulant rodenticides is widespread within the fisher’s range in California (Gabriel et al. 2012). The study found that four fisher deaths, including a lactating female, were directly attributed to anticoagulant rodenticide toxicosis. The study documented the first neonatal or milk transfer of these poisons to a fisher kit. These rodenticides pose both a threat of direct mortality or fitness risk to fishers, and a significant indirect risk to these isolated populations. The relationships between potential reduced fitness from rodenticide exposure, pressure from predation, and the effects of habitat alteration are not well known at this point; it is possible that these factors interact synergistically to reduce fitness.

A number of recent studies have focused on habitat use at various scales. A primary focus of these studies has been the development of tools that could support designing vegetation management projects and evaluating the effects of management treatments on fishers and fisher habitat. Spencer et al. (2011) developed a habitat model for fishers in the southern Sierra Nevada and coupled this model with a population model to assess the condition of habitat across the landscape and to estimate how many fishers might possibly occupy the space. This habitat model was expanded to include a model for denning habitat and an evaluation of movement habitat (Spencer and Rustigian-Romsos 2012; see partial results in Figure A-9). Thompson et al. (2011b) developed an analysis tool to evaluate the existing condition and post-treatment condition of a home range and related this to occupancy of the home range. Using relationships such as these, the paper suggests that this tool could be used to design vegetation management projects and assess their effects on habitat conditions. Lastly, Zielinski et al. (2010) developed a tool to assess habitat condition at a stand level and the effects of management on habitat conditions. This tool incorporates a common vegetation model to evaluate the changes in habitat conditions from timber harvest. The next step in the development of tools such as these is to integrate these tools into a multi-scale decision support tool to assist in conservation planning for fishers.

Desired Condition

In the desired future condition, the extant populations of fisher have expanded. Expanded populations in the Sierra Nevada provide a source for natural dispersal into formerly occupied range. Expanded populations outside the Sierra Nevada provide animals for future reintroductions and reflect a stable population on the West Coast of North America. Suitable habitat corridors facilitate active dispersal into former ranges. The landscape contains sufficient amounts of continuous, canopy-covered forest with hardwood trees for denning and felled logs and snags for resting sites. Fishers have been successfully reintroduced to areas with appropriate habitat conditions and a low likelihood of negatively affecting Pacific marten (*Martes caurina*). There is a reduction in anthropogenic hazards, like roads, use of rodenticides and trapping.

Objectives

- Ensure habitat connectivity for old forest associated species by managing large contiguous areas of late-successional forest linked by high capability habitat for dispersal.
- Manage human caused and naturally ignited fires, and post-fire forest landscapes, to maximize ecological benefits for fishers.
- Increase the connectivity of suitable habitats between southern Sierra fisher populations and the central and northern Sierra Nevada.
- Protect and restore black oak as a significant component of mixed-conifer forest ecosystems.
- Mitigate the anthropogenic effects of forest management activities.
- Identify and remove barriers to dispersal (e.g., highways and open forest areas).
- Improve wildlife road-crossing options on state and rural roads
- Complete carnivore detection surveys at the landscape level to:
    a. Describe the geographic range of fishers and other mammalian carnivores in the region,
    b. Collect data to develop and test regional habitat models for fishers and other carnivores,
    c. Provide baseline data for monitoring changes in population status for these carnivores,
    d. Understand the influence and interaction of habitat factors, community ecological factors, and anthropogenic effects on the distribution of carnivores in the region.

Conservation Measures

- Continue funding the fisher research associated with the Sierra Nevada Adaptive Management Project and the Kings River Fisher Study through at least 2016.
- Undertake a review of research needs for fishers in the southern Sierra Nevada, engage fisher scientists about research needs, and identify and fund a research program to support fisher conservation.
- Convene a group of scientists, specialists, managers, and stakeholders to develop a conservation strategy for fishers in the Sierra Nevada (Spencer and Rustigian-Romsos 2012).
- Retain and enhance remaining old-growth and late-successional forest stands.
- Develop a conservation strategy that establishes a series of fisher population centers that are inter-connected by areas of habitat suitable for dispersal. Use the habitat models developed by Spencer and Rustigian-Romsos (2012) to support the conservation strategy.
- Until a fisher conservation strategy is adopted for national forests in the southern Sierra Nevada follow the recommendations for forest management in the conservation strategy, including limits to timber harvest, provisions for over-fisher cover, large wood and large snags, and establishment of den buffers with limited management allowed.

- Develop marking guidelines to achieve retention of structures important for resting, denning, and hiding cover from predators.
- Ensure that suitable resting structures are widely distributed throughout home ranges of fishers and spatially interconnected with foraging habitats. Maintain, enhance, and do not degrade all suitable resting and denning habitat until a regional conservation strategy is adopted.
- Install over- or under-passes in stretches of highways with high fisher mortality rates.
- Reduce road density in fisher habitat.
- Design fuels reduction and restoration treatments to minimize reductions in canopy cover and canopy layering. Tree removal should focus on smaller diameter, shade-intolerant species.
- Reestablish and enhance patches of lush layered ground vegetation, snags, and fallen logs to provide conditions for abundant prey.
- Limit forest management activities in suitable denning habitat to avoid disturbance to individual denning fishers and direct take of denning individuals (e.g., limited operating period during denning seasons, March 1 to June 30) (Spencer and Rustigian-Romsos 2012).
- Create a den buffer (700 acres) around all known den sites. Limit activities within the den buffer to treatment of surface and ladder fuels or managed fire that results in low levels of mortality (less than 10 percent) in the dominant and co-dominant trees (Table A-7).
- Define objectives for use fire in constrained travel corridors to achieve low severity fire effects and to avoid stand replacing effects (Spencer and Rustigian-Romsos 2012).
- Avoid post-disturbance logging in fisher habitat (Naney et al. 2012).
- Form an inter-agency focus group to:
    a. Update pesticide labels to restrict over the counter use.
    b. Investigate the supply chain for rodenticide to marijuana plantations, and trace sources, and take regulatory actions for distribution pathways.
- Assess the impact of applying North et al. (2009) to forest management in the Sierra Nevada on fishers. Determine the scale at which heterogeneity benefits fishers. For example, evaluate need for patches of multistory stand structure in a treatment unit versus leaving 15-25 percent of units untreated.

Table A-7. Land allocations specific to Pacific fisher conservation.

Land Allocation	General Description	Management Objective
Forest Carnivore Den Sites	Den site buffer (700 acres for fisher; 100 acres for marten) designated around known maternal or natal dens.	Limit disturbance during denning (limited operating period). Retain habitat conditions that support denning. Limit vegetation management to reducing surface and ladder fuels to reduce fire risk until new science suggests otherwise. Restoration treatments do not remove larger white fir or incense cedar in these areas.

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Pacific Marten (*Martes caurina*)[4]

Issue Statement

The marten's range is broadly continuous across boreal forests of Alaska and Canada, but in the western United States its distribution is limited to mid and high elevation coniferous habitats. Population isolation has occurred in Oregon, Washington and California where marten were found in only 5 percent of their historic range (Zielinski et al. 2005). This substantial change distribution is most likely due to habitat loss because it occurred after hunting was outlawed in the 1950s (Buskirk and Ruggerio 1994). In the northern Sierra Nevada there is an apparent gap in the marten's distribution that is also likely related to logging of old forests (Zielinski 2004, Zielinski et al. 2005). Here, distribution appears concentrated in unmanaged forests of wilderness and National Parks (Zielinski et al. 2005, Rustigian-Romsos and Spencer 2010). Improving connectivity between high elevation old forests is a conservation priority for marten across the West, especially in the northern Sierra Nevada and Lassen region (Rustigian-Romsos and Spencer 2010).

Marten are closely associated with old forests because they provide safety from predators while resting and rearing young, as well as a diversity of prey throughout the year. Their habitat use is stratified by season, with upslope movement occurring in summer. Riparian areas and meadow edges also represent key foraging habitat in the Sierra Nevada (Spencer et al. 1983). Marten have high energetic needs and therefore foraging habitat is important year-round (Buskirk and Harlow 1989).

Distribution and Ecology

Elevation Range: The marten's elevation range in the Sierra Nevada has been variously described as ranging from 5,500-10,000 feet with marten occurring most often above 7,200 feet (USDA Forest Service 2001), and as ranging from 3,400-10,400 feet in the northern Sierra Nevada, with averages around 6,600 feet, and ranging from 4,000-13,100 feet in the southern Sierra Nevada, averaging 8,300 feet (Schempf and White 1977).

Habitat: Marten require structural attributes of old forests including dense overhead cover and coarse woody debris (large snags and downed logs). They are associated with relatively contiguous landscapes of old forest. Martens in Maine, Utah, and Quebec are associated with landscapes containing more than 70–75 percent mature forest (Bissonette et al. 1997, Chapin et al. 1998, Potvin et al. 2000). Similarly, Hargis et al. (1999) found that marten selected landscapes with no more than 25 percent of landscape lacking in old forest cover. Whether this applies to small openings, such as group selection, and not just to large openings such as clearcuts is an issue that has not been specifically addressed. Additional information is expected on the response of martens to openings as a result of research being completed by Katie Moriarty on the Lassen National Forest.

Complex physical structure near the ground is also an important habitat element (Buskirk and Ruggiero 1994, Buskirk and Powell 1994, USDA Forest Service 2001). In addition to large snags and downed logs, vertical live and dead tree boles also provide significant habitat structure (Slauson and Zielinski 2008), as does shrub cover. Hargis and McCullough (1984), in their study in Yosemite National Park, found that marten strongly selected for low overhead cover. Slauson et al. (2006), in their study in northwestern California, found that "dense shrub cover was the most consistent habitat element at sites selected by martens." (p. 465). Slauson and Zielinski

[4] Taxonomic review has identified martens west of the Rocky Mountain crest as a separate species (Pacific marten, *Martes caurina*) from those to the east (*Martes americana*) (Dawson, N. G. and Cook, J. A. In press. Behind the genes: Diversification of North American martens (*Martes americana* and *M. caurina*). In: K. Aubry, W. Zielinski, M. Raphael, G. Proulx, and S. Buskirk, editors. *Biology and conservation of martens, sables, and fishers: a new synthesis*. Cornell University Press, Ithaca, New York.)

(2007) reported a strong marten preference for dense (greater than 80 percent) shrub cover in the same study area. Buskirk and Ruggiero (1994) concluded that the marten's "preference and apparent need for structure near the ground, especially in winter, appears universal," likely due to protection from predators, access to subnivean (below snow) space, and thermal regulation (p. 22).

Marten are known to utilize a wider range of habitats than old forests, particularly riparian areas and meadow edges (Spencer et al. 1983). Their habitat use also appears to be stratified by season, with use of lower elevation mixed conifer in the winter and higher elevation red fir forests in the summer (Buskirk and Powell 1994, Buskirk and Ruggiero 1994, Rustigian-Romsos and Spencer 2010).

a) Reproductive and Resting Habitat: Typical rest site structures include the largest diameter live trees (red fir, lodgepole, and riparian associations), snags, platforms, and logs over 30" dbh (Spencer 1987, Martin and Barrett 1991, Slauson and Zielinski 2008). Atypical rest sites include man-made structures (wood piles, buildings) (Martin and Barrett 1991, Ellis 1998). Winter rest structures are frequently subnivean (logs, stumps and snags) (Slauson and Zielinski 2008).

Natal dens are typically found in cavities in large trees, snags, stumps, logs. Burrows, caves, rocks, or crevices in rocky areas are used less frequently (USDA Forest Service 2001). Den and rest site availability is so limited; it may also limit the marten's population (Ruggiero et al. 1998, Bull and Heater 2000). Indeed, resting and denning structures take over 100 years to develop and impacts to marten from their removal would extend over the next century.

Denning and resting habitat are described as follows (Spencer et al. 1983, Hargis and McCullough 1984, Ellis 1998, Ruggiero et al. 1998, Bull and Blumton 1999, Bull and Heater 2000, Bull et al. 2005, Slauson and Zielinski 2008):

- Late successional, old forests
- CWHR 5D and 6
- Canopy cover of at least 50 percent, mostly 60 percent and greater on the Westside Sierra Nevada
- Presence of large snags and logs on ground (coarse woody debris)

Bull and Blumton's (1999) study evaluated the impacts canopy cover reduction on marten and marten prey in eastern Oregon and found marten avoided areas with less than 50 percent canopy cover. Similarly, Bull and Heater (2000) suggest marten avoid stands with less than 50 percent canopy cover. Many marten experts report that martens select 60 percent or greater canopy cover for resting and denning (Ellis 1998, Ruggerio et al. 1998, Slauson and Zielinski 2008). Resting canopy cover requirements may be lower for marten in winter, when they use stands with canopy cover as low as 30 percent. However, key winter prey species such as Douglas and flying tree squirrels are associated with closed-canopy old forest conditions (Slauson and Zielinski 2008).

On the eastside of the Cascades and Sierra Nevada, marten show similar habitat associations. In one study, rest sites were generally characterized by large trees, with nearly half CWHR 5/6 and 40 percent CWHR 4 (Kucera 1996). Bull and Heater (2000), in mixed conifer forests of eastern Oregon, found that "Large-diameter hollow trees and logs, accumulations of coarse woody debris, and trees with brooms provided important habitat for resting sites"; the average diameter of trees with den structures was 33" dbh.

Coarse woody debris (large snags and downed logs) is also a significant resting and denning habitat element. This structure is especially important in winter, when it provides subnivean tunnels and access holes. Even low tree branches that reach toward the ground through snow provide important subnivean access. Sherburne and Bissonette (1994) found that when coarse woody debris covered a greater percent of the ground, marten use also increased. One study from the Cascades of California recommend 26.6 logs larger than 28 cm within 35 meters of rest sites, which converts about 27 large logs per acre (Slauson and Zielinski 2008). On field trips regarding marten studies being undertaken on the Lassen National Forest, Moriarty and others described the importance of jackstraw logs and high stumps for denning structures. Research on the Inyo National Forest, in eastside Jeffrey pine, similarly found that rest sites in trees were typically in large structures, averaging 40" dbh. (Kucera 1996, Kucera 2004). Rest sites are located where snag, down log and basal area densities are higher than surrounding forest (Kucera 2004). Older growth forests provide accumulated coarse woody debris necessary to enable marten to forage effectively during the winter.

Marten need many rest and nesting structures within each home range. Slauson and Moriarty (2010) report low rates of resting structure reuse in their research review. In fact, "Marten use resting sites daily, and availability of appropriate sites within their home ranges is essential to their well-being" (Martin and Barrett 1991, p. 41). Marten re-use of rest sites may also be stratified by season. In the summer, it appears as though marten use many novel rest sites within a home range. Martin and Barrett (1991) found that 15 percent of rest sites were reused, some on multiple occasions. Similarly, Spencer (1987) reported 12 percent re-use of non-subnivean sites. Conversely, during winter, 42 percent of subnivean rest sites were reused (Id). Spencer concludes that

> "A miscellany of resting sites scattered throughout the home range, each convenient to primary foraging patches, allows a marten to choose a resting site suitable to current conditions with a minimum of travel" (620-21).

b) <u>Dispersal Habitat</u>: There is relatively little research on marten dispersal. Bull and Heater (2001) report juvenile marten dispersed an average of 20 miles. Movement of up to 43 miles has been reported (Slauson and Moriarty 2010). Johnson et al. (2009) found that marten survival was inversely associated with dispersal distance, with mortality rates twice as high in clear cuts compared to forests. Buskirk and Powell (1994) conclude that marten will travel through forests that are not preferred habitat, but for how long and separated by what amount of higher quality habitat is not known.

c) <u>Habitat Modeling</u>: Rustigian-Romsos and Spencer (2010) developed a haitat model for the northern Sierra Nevada and southern Cascades region. The models show key areas where marten population cores and travel corridors are predicted. Authors introduce the figure as follows:

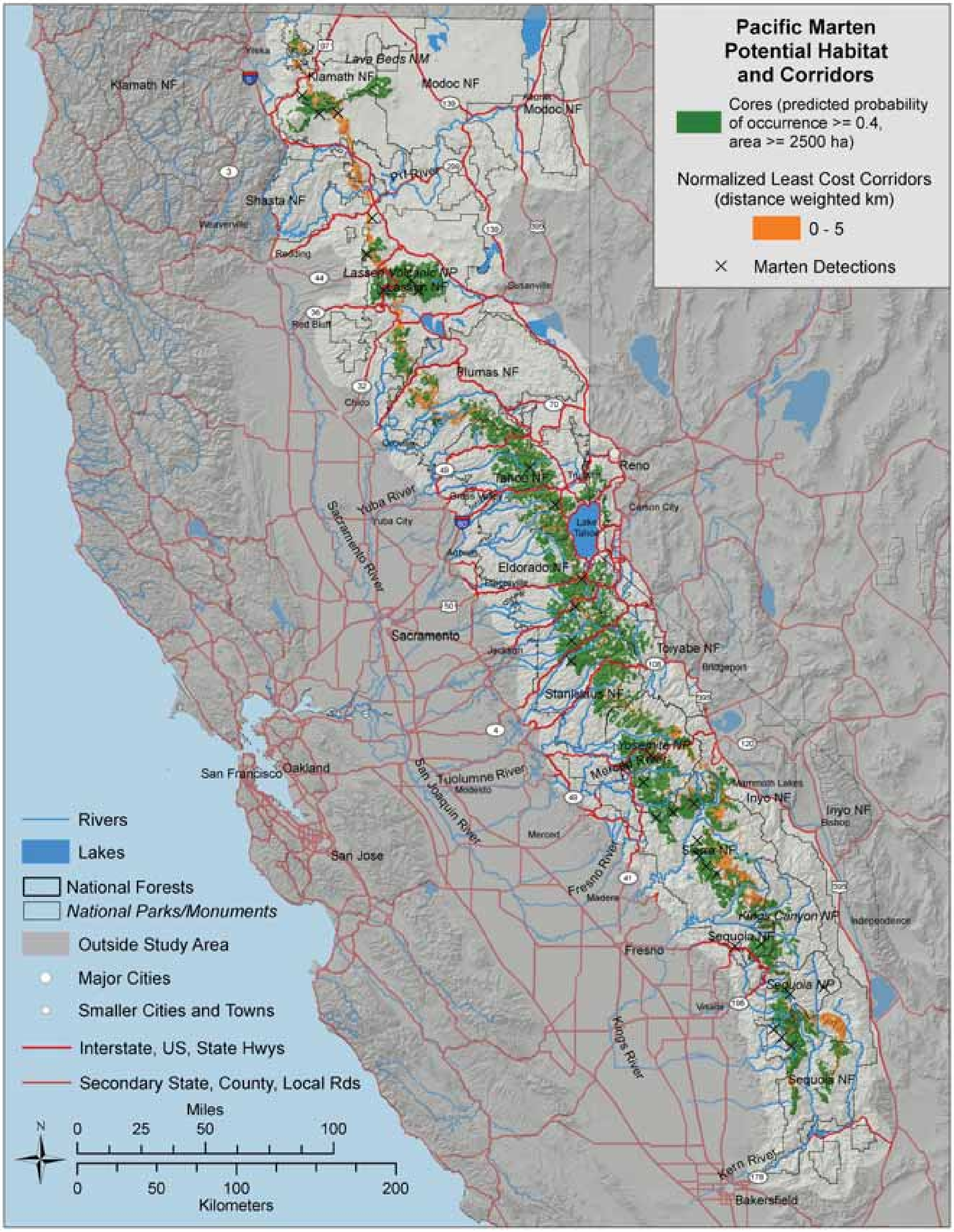
> …marten cores and connectivity areas [are] (delineated as 5-km-wide normalized least-cost corridors). Habitat connectivity does not appear to be greatly limiting for martens south from Plumas National Forest, but movement corridors are relatively long and constrained from Plumas National Forest north, where relatively xeric, lower elevation, and disturbed habitats separate the higher-elevation red fir forests preferred by martens.

Spencer and Rustigian-Romsos (2012) expanded their study of the Mount Lassen area to include the Sierra Nevada region to the south. Using a similar method of occupancy and movement modeling they modeled potential habitat and movement corridors for the inland mountains of California (Id.; Figure A-10). Similar to their earlier work, they found that:

> In the northern 1/3 of the study area, management should focus on protecting habitat quality within and around the perimeters of the core populations (Mount Shasta-Medicine Lake region; Mount Lassen-Swain Mountain-Thousand Lakes Wilderness region) and especially in and between the smaller cores, stepping stones, and connectivity areas between these regions, and between Mount Lassen and the more contiguous habitat core to the south (i.e., on the west slopes of the Plumas and Lassen National Forests).

(Spencer and Rustigian-Romsos 2012). Habitat distribution and availability was less limited in the southern two-thirds of their study region.

Figure A-10. Potential habitat and movement corridors for Pacific marten (Spencer and Rustigian-Romsos 2012).



Diet: Marten diet varies by season. In the summer key prey species include voles, ground squirrels, chipmunks, birds (Passerines and grouse), pocket gophers, deer carcasses, berries and insects (e.g., yellowjackets and others) (Buskirk and Ruggerio 1994, Slauson and Zielinski 2008). In the winter, key marten prey include Douglas tree squirrels, snowshoe hare, northern flying squirrels and deer mice (Slauson and Zielinski 2008). In a southern Sierra study, marten ate rodents (squirrels and voles), insects, hypogenous fungi and secondarily (less than 20 percent of diet) reptiles and birds (Zielinski et al. 1983, Zielinski and Duncan 2004).

Meadow voles (*Microtus* spp.) are a primary prey item throughout the year (Zielinski 1981). Voles require annual herbaceous thatch left over from the previous year for cover, typically 12-18" vegetation height in Sierra Nevada meadows (Greene 1995). Most publicly grazed Sierran meadows leave much to be desired for vole/marten habitat for a variety of reasons including over utilization by cattle permittees, hydrology of the meadow, and site capability. Although voles may proliferate in meadows, marten appear not to venture into meadows to hunt, but rather use riparian areas and edges along mixed conifer forest and meadows (Spencer et al. 1983, Hargis and McCullough 1984).

Reproduction: Pacific marten mate between June and August. Females gestate a fertilized egg over the winter and implantation of the egg in the uterus (delayed implantation) occurs in March. Marten kits are born in April. Females mate at 15 months and have their first litter by age 2. Females are solely responsible for raising young. They have a maximum of one litter per year and a range of 1-5 kits per litter, averaging 2-3 kits per litter. In years of environmental stress, pregnancy rates can be as low as 50 percent (Buskirk and Ruggerio 1994). Sexual dimorphism is strong, with males about 40 percent larger than females.

Predators: Mature forest loss makes marten vulnerable to predation at the home range and landscape scale (Slauson and Moriarty 2010). Documented predators of marten include coyote, fox, bobcat, golden eagle and great horned owl (Buskirk and Ruggerio 1994, Slauson and Moriarty 2010). Predators can utilize human-modified landscapes such as roads, managed forests and even snowmobile trails. For example, coyote follow snowmobile tracks over deep snow to hunt and/or compete with lynx (Kolbe et al. 2007). A similar impact is plausible for marten because unlike coyote, marten and lynx have similar foot adaptations for travel over deep unpacked snow where they would normally find coyote-free winter habitat.

Home Range: Mean home ranges in the Central Sierra Nevada are 960 acres for males and 801 acres for females (USDA Forest Service 2001). Marten home ranges are large relative to their body size, and vary to some extent based on prey availability and habitat type. For example, home ranges, including clearcuts, were 63 percent larger compared to home ranges in uncut forest in Maine (Buskirk and Ruggerio 1994). There is risk for marten with larger home ranges. Slauson and Zielinski (2008) report on a study that found marten home range size is inversely associated with survival and as home range increases so does the probability of predation. Johnson et al. (2009) found the same inverse relationship between home range size and survival.

Demography: Population estimates and trends are not available for marten in California. Hunting of marten has not been legal since 1954 (USDA Forest Service 2001). Declines in marten population size in the early twentieth century have been attributed to habitat loss, trapping and poisoning. More recently, logging has reduced habitat leaving populations isolated and poorly distributed (Buskirk and Ruggerio 1994, Slauson and Zielinski 2008).

Threats

There are a variety of potential threats to marten and marten habitat, include logging, roads, population isolation, fire, livestock grazing, poisoning, recreation and climate change. Marten experts identify several factors that make martens slow to recover from population-level impacts (e.g., habitat loss, poisoning, and auto collisions): 1) specialization with old forest habitat; 2) low reproductive rates; 3) large home ranges (Buskirk and Ruggerio 1994 p.16; USDA Forest Service 2001, Slauson and Zielinski 2008).

Population Size/Isolation: Habitat loss is thought to constrain marten movements (Bissonette et al. 1989, Chapin et al. 1997, Hargis et al. 1999), and to the extent that marten populations become geographically isolated from one another, there is an increased risk to genetic variability and ultimately extirpation (Buskirk and Ruggiero 1994). Habitat modeling of marten populations by the Forest Service indicates that the likelihood of extirpation may increase disproportionately in response to decreases in available habitat.

A total of 39 fisher from northwest California were released into the northern Sierra Nevada outside Chico from 2009-2011 (California Department of Fish and Game 2012). Competitive and aggressive interactions are known to occur among fishers and martens at the margins of their ranges where they may overlap. Fishers transplanted from northwestern California are larger than fishers form the Sierra Nevada. Because of their increased size, these transplanted animals may pose an even greater threat as competitors or aggressors to marten living in the area.

Habitat Fragmentation/Habitat Loss: Marten are old forest specialists. Their habitat is fragmented and at risk in the Sierra Nevada. Fire and insects can be sources of habitat loss, however "because logging is unique among these disturbances in removing boles from forests, and because of the importance of boles in contributing physical structure to habitats, logging likely is more deleterious to habitat quality for martens than other disturbances" (Buskirk and Ruggerio 1994).

a) Logging: Logging poses a potential negative impact on marten when it reduces canopy cover below the desired 50-100 percent, or when diseased and deformed trees are removed. Such logging activity on public lands includes group selection, Defensible Fuel Profile Zones (DFPZs), thinning from below (or the middle), individual tree selection, and post-disturbance logging. Bull and Heater (2000, p. 184) discuss their concerns regarding impacts of fuel reduction logging on marten:

> Large-diameter hollow trees and logs, accumulations of coarse woody debris, and trees with brooms provided important habitat for resting sites. The silvicultural practices of removing trees with brooms, removing hollow trees, and reducing fuels (coarse woody debris) to lower the risk of or damage by wildfire may negatively alter marten habitat."

The impacts of logging practices such as DFPZs or thinning from below on marten habitat would likely depend on a variety of factors including remnant canopy cover (including low overhead cover), the extent of removal and retention of large structures, and the extent to which potential rest and den structures are protected (e.g., damaged and diseased larger trees). Classic, thinning from below and DFPZs would not appear to provide habitat for marten based on relatively low resulting canopy cover (40 percent or lower), lack of complex physical structure near the ground, removal of large trees, snags, and logs, and removal of diseased and deformed trees. DFPZs are expected to result in "relatively open stands" in which "the forest floor would usually be relatively open, with the exception of occasional large logs" (USDA Forest Service 1999, p. 2-20). However, practices such as retaining leave islands with higher canopy cover and higher shrub cover, retaining large snags and large downed logs, would appear to benefit marten.

The Fish and Wildlife Service has expressed concerns that "marten may not move across linear DFPZs, limiting population expansion and colonization of unoccupied habitat … thus precluding future recovery options." (USDI Fish and Wildlife Service 1999, p. 12). Similarly, the Forest Service itself has expressed concerns that DFPZs, especially in the red fir zone, "could create open forest conditions that are no longer suitable for marten, and are large enough to serve as potential barriers to movement" (USDA Forest Service 1999, p. 123). Whether DFPZs would create a barrier to marten movement has not been specifically researched and would likely depend on the resulting vegetation, width and location. Certainly, DFPZs and other logging located in the Lassen area and the Northern Sierra Nevada would raise utmost concern for marten in the region.

Ellis (1998) and Kucera (1996) (also discussed in the habitat section above) are sometimes cited to illustrate marten's tolerance of forest gaps or sparse canopy cover. Ellis described 19-61 percent mature forest at the home range scale. The author offers that the recent shelterwood stands in her study surrounded the smaller old growth stands where marten preferred to rest and den, making it necessary for marten to travel through the shelterwood stands. Further, five female mortalities occurred in or on the edge of (within 10m) shelterwood cuts during her study. Rather than a tolerance, this study may illustrate the predation risk for marten denied forest and/or shrub cover. Similarly, the research in the Lassen area reports 80 percent of marten mortalities were suspected predation events in a region where habitat fragmentation is a concern (Slauson and Moriarty 2011). Kucera (1996) notes that habitat use at the edge of the species range in his study may not represent habitat needs of the core reproductive population. It is worth noting that no animals were found reproducing during his study.

Key winter prey species could be impacted by logging as well. The Douglas and flying tree squirrels are associated with closed-canopy old forest conditions (Slauson and Zeilinski 2008). These species are likely to decline in stands experiencing disturbance from logging or severe fire for 2-10 years (Id).

b) Fire: Potential impacts of wildfire on marten vary. Some research shows high marten use of forests post-fire, where complex physical structures remain on the ground, such as down wood or dense herbaceous vegetation; other studies report minimal use of post-fire forest by marten (Buskirk and Ruggiero 1994). Presumably the impacts of fire on marten would depend upon factors such as the remaining vegetation and structure, and the area affected by severe fire. High elevation red fir and lodgepole pine forests have a relatively low fire return interval, although when it burns the fires can be stand-replacing. Wildfire management plans should identify low severity fire effects as the objective in areas important to marten movement and where movement is otherwise constrained (e.g., narrow areas with low levels of suitable movement habitats.

High intensity prescribed fire has the potential to consume large woody debris on the ground or standing snags that provide important marten habitat. Prescribed fire may increase prey availability temporarily by releasing herbaceous plants from conifer competition, especially in riparian areas overgrown with conifers, and in small grasslands and meadows. The fire effects and benefits from managed fire need to be planned carefully to achieve the desired balance of disturbance to create a varied structure and conservation desirable habitat attributes.

c) Recreation and Urban Expansion: Alpine ski areas are located in marten habitat especially near Lake Tahoe. Several cursory studies investigated the impact of winter and summer recreation activities on marten and reported varied impacts including loss of forest and subnivian habitats, diversion to dumpster food sources, human disturbance from recreation and parking areas, and road mortality (Cablk and Spaulding 2003). Impacts of ski areas are still widely unknown and should be investigated further. Marten may cross open areas under ski lifts and across ski runs during winter (Id). However, whether marten forage in such areas, or merely cross them, is not clear. According to researchers, "no statements can be made regarding how animals are using the habitat within Heavenly [ski area] without additional snow track data and/ or telemetry studies" (Id., p. 69). Urban expansion poses similar threats to ski areas with habitat loss, road mortality and disturbance.

Roads: Road collisions are a source of marten mortality (Buskirk and Ruggerio 1994) including in the Sierra Nevada (Spencer 1981, Martin 1987). There are 12 major highways bisecting marten habitat in the Sierra Nevada at intervals of only about every 30-50 miles. They represent a deadly and ubiquitous threat to marten survival throughout their range.

Roads also introduce novel high elevation species assemblages during winter months where prey is sparse and historically only species adapted for deep snow would tread (i.e., wolverine and marten). Thus, roads facilitate species introductions to high elevations in winter that compete for food and prey upon marten (such as coyote).

Cattle Grazing: Grazing has impacted riparian areas throughout the Sierra Nevada. Marten frequently use riparian habitats in the Sierra Nevada, and grazing is a likely negative impact on this habitat (Spencer et al. 1983, USDA Forest Service 2001). Livestock grazing can also result in the loss of riparian areas through channel widening, channel degradation or lowering of the water table (Kauffman and Krueger 1984, Kattelmann and Embury 1996). National Forest regulations currently exist to protect riparian areas; however, these are inconsistently applied. For example, cattle grazing permittees are now charged with monitoring their own use and reporting back to the agency, furthering the vulnerability of these areas to overuse.

Rodent Poison: Poisoning, shooting and trapping of marten is illegal in California, however non-target effects of rodenticide is a potential concern in marijuana plantations (R. Bridgman, Stanislaus National Forest, personal communication, July 2012). Fisher show alarming rates of exposure to rat poison from marijuana plantations in the southern Sierra Nevada (Gabriel et al. 2012). Potential impacts to marten are similar.

Lack of Information: Research is needed to clarify seasonal habitat and prey needs of marten in the Sierra Nevada. For example, CWHR models over-predict the availability of marten habitat in the Sierra Nevada (Rustigian-Romsos and Spencer 2010). Thus, agency estimations of forest management impacts on marten habitat are likely underestimated. Genetics information on populations is also urgently needed to gauge the status and demography of Sierran populations.

Climate Change: An additional threat to marten is climate change. Because they depend on snow cover in winter, the potential loss of 30-60 percent of snow pack across the species range due to warming trends in the lower-48 states poses a huge risk to the species. The marten in the Sierra Nevada is at the southernmost extent of its North American distribution, and thus is at greatest risk from climate change (Buskirk and Ruggerio 1994, USDA Forest Service 2001). To the extent that Sierra Nevada forests become hotter or drier, climate change would be expected to adversely affect marten by reducing subnivean cover in the winter time, altering winter prey availability and species, restricting movement, and increasing the likelihood of local extirpation. As snow depth decreases, the marten's need for more coarse woody debris cover increases, emphasizing its importance in forest management activity (Corn and Raphael 1992).

Desired Condition

- Sierra Nevada marten populations are stable or increasing.
- Southern Cascade populations are connected to each other and to Sierra Nevada populations.
- Marten travel and dispersal habitat is clearly defined, contiguous and of high quality.
- Marten den and rest sites are protected.

- A Region 5 management plan is in place for monitoring and conservation of marten.
- Herbaceous cover in riparian and meadows is adequate to support voles.
- Activity that may impact marten such as snowmobile use, ski resorts and busy roads are managed to minimize impact on marten.
- Protective measures maintain known or high probability special habitats or sites during project planning and implementation.
- Fire in constrained travel corridors is low severity until there are improved opportunities for movement.
- Marten are free from exposure to rodenticide and other poisons.

Objectives

- Develop marking prescriptions with support from marten experts that clearly describe how to mange forests while retaining important habitat structure for marten, i.e., high canopy cover, old forest, large woody debris, large snags, ground cover, patches of dense forest, leave islands, contiguous forest cover, quality habitat linkages between watersheds and across landscapes.
- Assess gene flow among and between Sierra Nevada and Cascade marten populations.
- Identify isolated marten populations.
- Enhance habitat connectivity between marten populations.
- Locate marten den and rest sites on each forest within 4 years of forest plan implementation.
- Conduct surveys for marten in the summer (May-November) because summer breeding habitat availability is more limiting.
- Conduct empirical studies on what vegetation types are used by dispersing marten.
- Evaluate, maintain and enhance Sierra Nevada marten habitat connectivity within the Sierra Nevada and the west coast populations.
- Ensure forest management objectives address marten habitat connectivity and movement, especially in the northern Sierra Nevada and Cascades.
- Manage old forest areas for marten denning, resting, hunting and for travel corridors within their range.
- Maintain and enhance key old forest structural elements including large snags, large downed logs and large standing live trees.
- Protect and enhance old forest cover.
- Return degraded Sierra Nevada meadows to more mesic conditions to support vole populations.
- Manage capable Sierra Nevada meadows and grasslands for voles.
- Prevent illegal rodenticide use on National Forests.
- Protect marten habitat from ski area expansion until impacts are better understood.
- Identify roads that pose significant risk to marten and improve passageways and speed enforcement in those areas.

Conservation Measures

- Follow the recommendations for forest management in the conservation strategy, including limits to timber harvest, provisions for over-fisher cover, large wood and large snags, and establishment of den buffers with limited management allowed.

Table A-8. Land allocations specific to Pacific marten conservation.

Land Allocation	General Description	Management Objective
Forest Carnivore Den Sites	Den site buffer (700 acres for fisher; 100 acres for marten) designated around known maternal or natal dens.	Limit disturbance during denning (limited operating period). Retain habitat conditions that support denning. Limit vegetation management to reducing surface and ladder fuels to reduce fire risk until new science suggests otherwise. Restoration treatments do not remove larger white fir or incense cedar in these areas.

- Seek input and review from a team of marten experts to evaluate landscape-level and stand-level actions using appropriately scaled maps from Spencer and Rustigian-Romsos (2012; data also available from Conservation Biology Institute upon request).
- Maintain and enhance marten habitat quality outside the Community Zone (0.25 mile buffer around communities and infrastructure).
- Retain all available den and rest structures, including large snags, downed logs in decay classes 1 and 2, large standing boles, cavities in large trees, within the elevational range for marten and outside the Community Zone (0.25 mile buffer around communities and infrastructure).
- Implement marking prescriptions that clearly retain important habitat structure for marten per corresponding objective above.
- Retain all available habitat structures, including 60 percent or greater canopy cover, multilayered canopy structure, shrub cover, and abundant snags, short stumps and large down logs (e.g., greater than 20 logs per acre were found at rest sites (Martin (1987)), within the elevational range for marten and outside the Community Zone (0.25 mile buffer around communities and infrastructure).
- Establish a limited operating period during the denning season (May 1 to July 31) within 5 miles of a marten den or rest site.
- Avoid post-disturbance logging in marten habitat.
- Modify hazard tree logging to maintain all marten habitat structures (i.e., fell and leave hazard trees) where retaining such material is not a direct threat to human safety or property.
- Maintain a vegetation height at 12" or greater in meadows capable of supporting voles.
- Continue to manage roadless areas as roadless and protect new roadless and wilderness areas as they are identified.
- Limit over snow vehicle travel within 5 miles of a marten detection.
- Define objectives for use fire in constrained travel corridors to achieve low severity fire effects and to avoid stand replacing effects (Spencer and Rustigian-Romsos 2012).
- Form an inter-agency focus group to: 1) Update pesticide labels to restrict over the counter use; 2) Investigate the supply chain for rodenticide to marijuana plantations, trace sources, and take regulatory actions for distribution pathways.
- Investigate impacts of thinning, forest health, and fuels reduction projects on key habitat elements including: canopy cover, bole density, coarse woody debris, potential rest sites, home range and landscape composition and fragmentation. Marten response variables should include: seasonal habitat use, home range size, and key winter species (Slauson and Zielinski 2008).
- Study impacts of ski areas on marten.

- Assess the impact of applying North et al. (2009) to forest management in the Sierra Nevada for martens. Determine the scale at which heterogeneity benefits martens. For example, evaluate need for patches of multistory stand structure in a treatment unit versus leaving 15-25 percent of units untreated.

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Wolverine (*Gulo gulo*)

Issue Statement

Wolverines are relatively abundant in Alaska and Canada, and their distribution extends into the contiguous United States from the north-east, Great Lakes region, and northern mid-west. In the western U.S., wolverine were documented from 1801-2005 in the Rocky Mountains of Idaho, Montana and Wyoming, the mountainous regions of Arizona and New Mexico, the Cascade Mountains of Washington, and California's central and southern Sierra Nevada (Aubry et al. 2007). The highest elevation terrain in the Sierra Nevada, from Yosemite to Sequoia-Kings Canyon National Parks, provides the highest quality wolverine habitat due to its persistent snow cover (USDA Forest Service 2001, Schwartz et al. 2007).

Wolverines live in alpine and arctic habitats and are strongly associated with the presence of deep snow. Wolverines eat small mammals in the summer and scavenge food in the winter. They have wide heads and strong neck muscles to eat frozen bone and drag large carcasses. They persist at extremely low numbers and reproduce very slowly, resulting in populations that are particularly vulnerable to trapping and other human disturbance (e.g., snowmobiles).

Distribution and Ecology

Elevation Range: Wolverines occur between 2,100-2,600 m (6,800'-8,500') in arctic, sub-arctic and alpine habitats in North America. Their seasonal elevation range shifts only slightly, with a difference of 99 m (324') between summer and winter range, presumably due to prey availability (Copeland et al. 2007). Wolverines occur at higher elevations as latitude decreases (Aubry et al. 2007). Consequently, animals in the Sierra Nevada are expected to reside at the higher end of the species elevation range because they are at the southernmost latitudinal range. Indeed, Joseph Grinnell noted that by 1893 wolverines were restricted in California to high-elevation 2,500–4,000 m (8,200-13,100’) alpine and subalpine habitats in the southern Sierra Nevada (Schwartz et al. 2007).

Habitat: The strongest correlation for wolverine occurrence in the Western US is deep snow that persists until mid-May (Aubry et al. 2007). Vegetative characteristics appear less important to wolverine than physiographic structure of the habitat (Ruggiero et al. 1994). Snow in early spring best explains all wolverine records in the United States ($r^2 = 0.60$) (Aubry et al. 2007). Copeland et al. (2007) found that rock and ice are positively associated with wolverine territories, but suggest that rock is simply a surrogate for elevation, and that there is no direct correlation between rock and wolverines.

Wolverines in the Pacific states occur within or near alpine areas including alpine meadows, barren areas, and montane conifer forests that offer low temperatures and late spring snow cover. Confirmed sightings of wolverine in California were within 1 km of meadows or barren areas (Aubry et al. 2007). Grass and shrub cover was a negative indicator of wolverine presence in Idaho (Copeland et al. (2007).

Moderate overhead cover may be important for resting sites as well as natal and maternal dens. Two radio-telemetry studies found 70 percent of wolverines occurred in montane coniferous forest types with medium to scattered timber (Copeland et al. 2007, Hornocker and Hash 1981). Rest sites in Montana were often in snow with timber cover (Ruggiero et al. 1994). Key conifer species in Idaho include whitebark pine, lodgepole pine and Douglas fir (Copeland et al. 2007). Females and subadults were associated with whitebark pine more than 94 percent of the time in summer. The USDA Forest Service (2001) reports that wolverine are associated with dense forest cover, however no source material is provided.

Reproductive habitat: Two historic natal dens have been reported in California, both were above 10,000’ elevation and near rock shelves (USDA Forest Service 2001). Habitats that provide the appropriate structures, such as large cavities, coarse woody debris, and old beaver lodges, likely will provide den sites (Ruggiero et al. 1994).

Diet: Wolverines are primarily scavengers and rely on other large predators to leave behind bones and fur. They depend on ungulate carcasses throughout the winter. Greater availability of caribou, elk and moose carrion in the northern extent of their range explains increased population size in these areas (Ruggiero et al. 1994). Wolverine may also eat live marmot, snowshoe hare, mink, weasel, marten and other rodents (Id).

Reproduction: Reproductive age for wolverine is estimated at more than three years of age (USDI Fish and Wildlife Service 2008). It may take females two years of foraging to store enough energy to sustain pregnancy and rearing (Id).

Dens are typically used from early February through the spring into May (USDI Fish and Wildlife Service 2008). Natal dens where kits are born are long, complex tunnels in the snow requiring at least 1.5 m (5’) snow depth. In Alaska, they may include features such as logs, boulders, and dry river beds (Aubry et al. 2007). Natal dens in Montana were most commonly associated with snow-covered tree roots, log jams, or rocks and boulders (Ruggiero et al. 1994). Females go to great lengths to find secure den sites, suggesting that predation is a concern (USDI Fish and Wildlife Service 2008). A female may move kits to several different dens over the course of a season, possibly in response to disturbance, predation risk, or deteriorating den condition such as snow melt.

Predators: Wolverine predators include humans, bears, mountain lion, eagles (on wolverine kits), and wolves. Aubry et al. (2007) suggest that wolverine do not occupy elk winter range despite the abundance of prey in order to avoid mountain lion. Breeding season aggression may also be a source of conspecific mortality (Ruggiero et al. 1994).

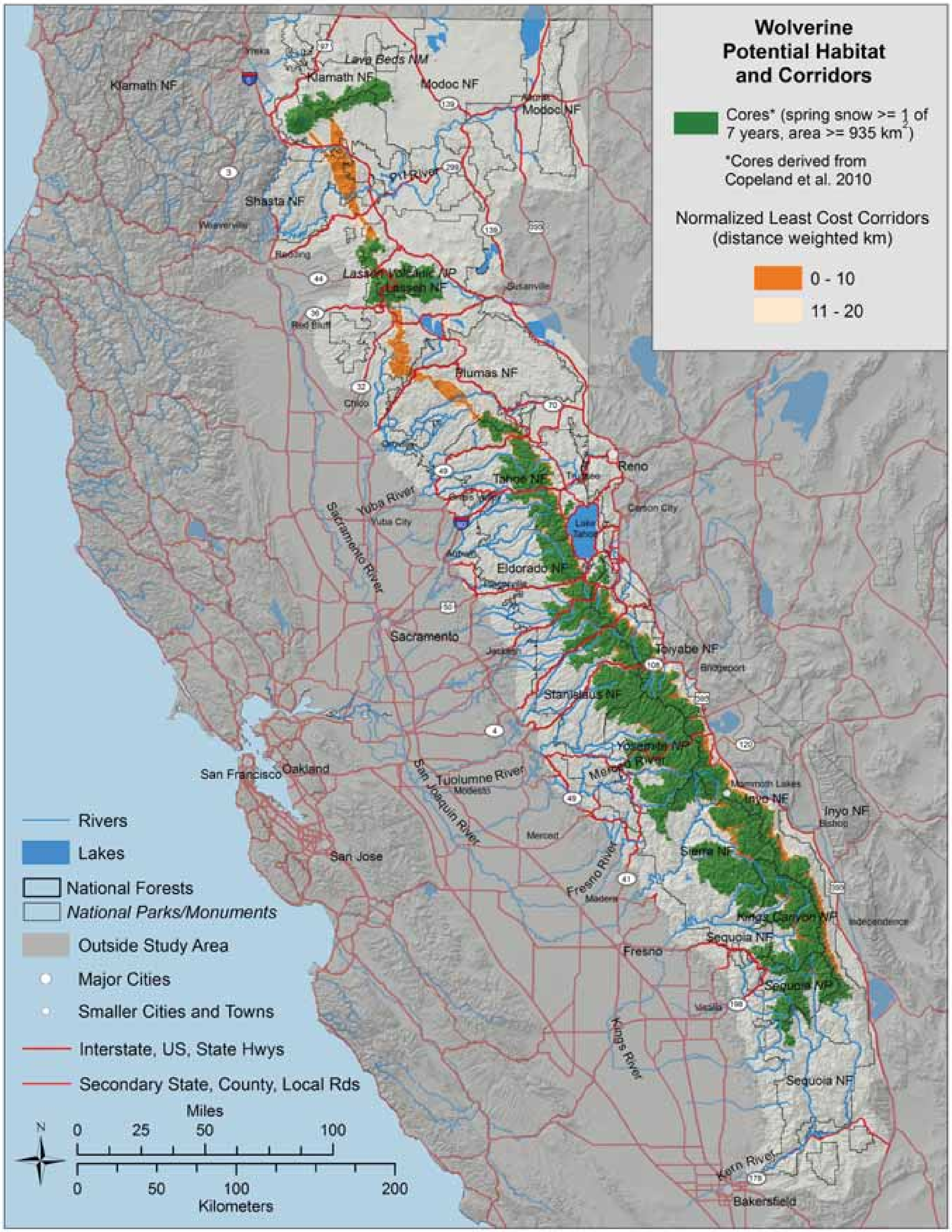
Home Range: Wolverines occur in low densities, averaging one animal per 150 km2 (58 mi2) (USDI Fish and Wildlife Service 2008). Adult wolverine home ranges in North America can be less than 100 km^2 or as large as 900 km^2 (38 to 560 mi^2) (Ruggiero et al. 1994, California Department of Fish and Game 2005, USDI Fish and Wildlife Service 2008). The variation in home range sizes among studies may be related to differences in the abundance and distribution of food (Ruggiero et al. 1994). Therefore, individuals at the southern tip of the range, in California, may have the largest home ranges. Wolverine can cover up to 32 km^2 (19.4 mi) a day in Montana, and will travel 10-15 km (6-9 mi) without rest (Ruggiero et al. 1994). Hunting routes can cover up to 2,070 km^2 (800 mi^2) (California Department of Fish and Game 2005).

In 2009, two remarkable long distance movements were documented as two male wolverine independently dispersed across inhospitable habitat. In March 2009, a male wolverine whose genetics were traced back to the Sawtooth range in Idaho traveled to the Central Sierra Nevada. This individual is likely to have traveled by foot (not aided by humans) because of the remoteness of the Sawtooths and the fact that trapping is not allowed there. The second dispersal event occurred in June 2009 when a radiocollared male traveled over 500 miles from Montana to Colorado. He crossed over 100 miles of sagebrush habitat and Highway 80. These two examples exemplify the extraordinary abilities of this animal and could be associated with climate conditions in 2009 that led to such extreme dispersal events.[5]

Based on these habitat associations, Spencer and Rustigian-Romsos (2012) developed habitat models for wolverine in the Sierra Nevada (Figure A-11).

[5] The Central Sierra Environmental Resource Center has been using remote cameras in a cooperative effort with both the Stanislaus National Forest and Yosemite National Park to assess the presence of rare forest carnivores. A key focus of CSERC's photo-detection survey efforts is to detect wolverine and Sierra Nevada red fox in areas where previous surveys have not extended into remote areas of suitable habitat. During surveys last year and to date in 2012, CSERC has not detected wolverine, but the Center's baited camera stations have successfully photographed Sierra Nevada red fox, American marten, and diverse other wildlife at the high elevation cameras, including weasel, bobcat, marmot, deer, bear, snowshoe hare, porcupine, and various rodent and bird species.

Figure A-11. Potential habitat and movement corridors for wolverine (Spencer and Rustigian-Romsos 2012).



Demography: California wolverines represent a distinct population segment from the other North American wolverine (Schwartz et al. 2007). The genealogical relationship among mDNA sequences indicate that Sierra a split early on in the species North American colonization. There is concern with the low effective population size of wolverine in the lower 48 states (number of individuals contributing to reproduction). The US Rocky Mountains estimated population size is 39 individuals. This is well below the 400 pairs needed for short-term maintenance of genetic diversity (USDI Fish and Wildlife Service 2008).

Threats

Wolverines occur at low densities, making detection and determination of the effects of management activities difficult (Ruggiero et al. 1994, McKelvey et al. 2008).

Population Size/Isolation: Wolverine demography is particularly vulnerable to adult mortality and low immigration rates (Aubry et al. 2007). Wolverines in the continuous US "appear to exist in small, fragmented and semi-isolated populations that put them at greater risk of being lost due to catastrophic or stochastic events than those populations to the north…" (USDI Fish and Wildlife Service 2008, p.12936). Rocky Mountain and Sierran population isolation from Canada is a concern. The Rocky Mountain population may not be sufficient to sustain itself and provide for dispersal into the Pacific Northwest and Sierra Nevada. The small effective population size is contributing to inbreeding and loss of genetic diversity. Genetic diversity is important to maintain resilience to climate change, dispersal obstacles, disease, shifts in prey species, etc. The risk to Sierran wolverine population may be even greater because it has been isolated from other populations for the last 2,000 years (Schwartz et al. 2007). Wolverine in the Sierra Nevada has "*the most significantly declining trend and most significantly contracted range and also the highest vulnerability class*" compared to any other animal in the Sierra Nevada (USDA Forest Service 2001).

Habitat Fragmentation/Availability: High elevation alpine and sub-alpine wolverine habitat exist as isolated 'islands' surrounded by less suitable or non-habitat. Intermountain valleys with human development and roads increase habitat isolation and further diminish potential for dispersal and movement between sub-populations. Climate change poses additional threats to this habitat. "The highly fragmented nature of the habitat in the contiguous US contributes to the low effective populations size for wolverines [in the Rocky Mountain area] …making the continued persistence of the population precarious relative to the Canadian population." (USDI Fish and Wildlife Service 2008, pg. 12938).

Wolverine are capable of traveling long distances to recolonize habitat, however, female recolonization may be limiting since they usually establish territories adjacent to their natal areas (Ruggiero et al. 1994). Lack of refugia habitat and movement corridors may limit the populations' ability to persist (Id.). The Forest Service reports that providing adequate quantities of connected forest within the Sierra and between the Sierra and Cascade mountains is critical to the recovery of the species in California (USDA Forest Service 2001). Adequate denning habitat is also called for: "Den sites in forested areas described to date suggest that physical structure may be important for denning. Low availability of natal dens may limit reproduction in some areas, especially those that have been extensively modified by logging or other land-use practices." (Ruggiero et al. 1994).

Prey Availability: Wolverines have high energetic requirements and live in relatively unproductive areas. As a result, starvation is a concern for the species, especially in areas like the Sierra Nevada where wolves and grizzly bears no longer provide important carcasses for wolverine (Ruggiero et al. 1994). Forest uses that reduce ungulate numbers may reduce an important source of prey availability. Wounding mortality of ungulates from hunting most likely provides a consistent carrion source (Ruggiero et al. 1994). Both deer and marmot are negatively affected by grazing in California (California Department of Fish and Game 1998, California Department of Fish and Game 2005), and cattle grazing could affect summer wolverine prey availability. Conversely, some argue that livestock grazing provides carcasses for wolverine. However, cows and sheep don't provide a reliable prey source since permittees go to great lengths to avoid loss of livestock. Migratory mule deer live at high elevations in the Sierra Nevada and provide some carcass for wolverine, at least three seasons per year.

Human Caused Landscape Alteration: Grazing, back country skiing and snowmobiling, climate change, forestry, hydroelectric power development, human settlement, and population growth all have affected the productivity and integrity of habitat within wolverine range and warrant careful consideration. Impacts of logging can only be surmised according to Ruggiero et al. 1994):

> A preference by wolverines for mature to intermediate forest in Montana (Hornocker and Hash 1981) was not apparent in southwest Yukon (Banci 1987) or in south-central Alaska (Gardner 1985). Hornocker and Hash (1981) reported that although wolverines in Montana occasionally crossed clearcuts, they usually crossed in straight lines and at a running gait, as compared to more leisurely and meandering patterns in forested areas (Ruggiero et al. 1994).

Logging of mixed conifer, lodgepole pine, and red fir habitats in the higher elevations and latitudes of the Sierra Nevada have the potential to disturb or destroy denning sites, prey habitat, or hunting cover for wolverine. Habitat quality and connectivity in the Northern Sierra Nevada connecting the Cascades with higher quality habitat in the Southern Sierra should be evaluated and protected.

An additional threat to wolverine is climate change. Because wolverine are so closely associated with deep snow cover and depend on deep snow for denning, the loss of 3-60 percent of snow pack across the species range warming trends in the lower-48 states poses a huge risk to the species. Climate change may also reduce winter kill of ungulates, thus reducing carrion availability throughout the winter months when food is already scarce.

Human Disturbance: Many studies report the potential for human disturbance to wolverine from back country recreation, development and roads (Ruggiero et al. 1994, USDA Forest Service 2001, USDI Fish and Wildlife Service 2008). Wolverine may be pushed into less desirable habitat or may be forced to move den sites to less secure locations due to backcountry recreation activities (Ruggiero et al. 1994). Natal dens are particularly sensitive to disturbance, and in Idaho females with kits have responded negatively to human disturbance (Id.). Copeland et al. (2007) were the only researchers to report a lack of sensitivity to human presence in Idaho, demonstrated by wolverine frequenting active campgrounds, unoccupied hunting lodges, recent snowmobile tracks, and garbage dumps in Canada. They suggest that the negative association of wolverine with people could be an artifact of the remoteness of high elevations where wolverines occur.

Trapping: Wolverines are still actively trapped and hunted in Montana, Alaska and Canada. Sadly, wolverine demography in the lower 48 states is highly vulnerable to adult mortality, but averages of 10 adults per year are still killed in Montana. There is great concern among scientists for wolverine population viability in the US Rockies.

The greatest number of wolverines was reported in California in 1921-1930 when 30 wolverines were verified (primarily dead specimens) (USDI Fish and Wildlife Service 2008, Table 1). Two more were killed by Grinell in Yosemite during this time. It was an absolutely dismal decade for California's top predators, as the last known California grizzly was killed in 1922 and the last California wolf was killed in 1924. This period of zealous collection and poisoning of wolverine to protect livestock was followed by a presumed extirpation of wolverine in the state, when only a single animal was confirmed during an 80 year period (USDI Fish and Wildlife Service 2008, McKelvey et al. 2008).

Desired Condition

- A management plan for Region 5 is in place for monitoring and conservation of wolverine.
- Sierra Nevada wolverine population is stable or increasing.
- Activities that may impact wolverine, such as snowmobile use, ski resorts and busy roads, are managed to minimize impact on wolverine where recent sightings have occurred.
- Adequate security from motorized access in occupied and dispersal areas is provided in all seasons.
- Secure areas for wolverine are large in size, provide sufficient cover, and are outside the influence of the motorized routes (USDA Forest Service 2006).
- Protective measures maintain known or high probability special habitats or sites (USDA Forest Service 2006).

Objectives

- Conduct a wolverine survey to determine the current distribution of the wolverine in the Sierra Nevada (USDA Forest Service 2001).
- Develop a wolverine recovery plan with California Department of Fish and Game (USDA Forest Service 1990).
- Evaluate, maintain and enhance Sierra Nevada wolverine habitat connectivity to other larger populations in the Cascades and Rockies (Magoun 2005). Protect and enhance true fir forest cover, minimize road and OHV route density. Because wolverine populations in the lower 48 states are small and isolated, an assessment landscape features that facilitate or impede immigration is critical for wolverine conservation (Ruggiero et al. 2007).
- Evaluate potential new wilderness and roadless areas for protection.

Conservation Measures

- Evaluate the impact and determine appropriate placement of fuels and forest health projects in northern Sierra Nevada on wolverine movement areas linking the Cascades and Central/Southern Sierra Nevada (USDA Forest Service 2001).
- Investigate, evaluate, and monitor sighting reports in coordination with the California Department of Fish and Game (USDA Forest Service 1990).
- If resident animals are discovered, inform and cooperate with California Department of Fish and Game and wildlife researchers to insure the protection of the animals (USDA Forest Service 1990).
- Implement recovery objectives when a plan is completed (USDA Forest Service 1990).
- Protect and enhance true fir forest and special habitat features associated with the species, e. g., talus slopes, boulder fields; beaver lodges; old bear dens; fallen logs; root wads of large, fallen trees; log jams, and large cavities (USDA Forest Service 2010) with in 5 miles of wolverine detection.
- Limit off road and over snow vehicle travel within 5 miles of wolverine detection. High-elevation cirque basins are particularly sensitive during winter and early spring due to association with den sites and should be protected from human disturbance (USDA Forest Service 2006).
- Prohibit new recreation development, and limit helicopter skiing, backcountry skiing and snowmobiling within 5 miles of wolverine detection. Wolverine are sensitive to human recreation activity during winter near den sites (USDA Forest Service 2010).

- Continue to manage roadless areas as roadless and protect new roadless and wilderness areas as they are identified.

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BIRDS

This section provides species accounts and conservation recommendations for the following birds (Table A-9).

Table A-9. Native birds with species accounts and conservation recommendations presented in this appendix (California Department of Fish and Game 2011).

Scientific Name	Common Name	Status
Strix occidentalis occidentalis	California spotted owl	FSS, MIS
Strix nebulosa	Great gray owl	CE, FSS
Accipiter gentilis	Northern goshawk	FSS
Dryocopus pileatus	Pileated woodpecker	Species of interest

California Spotted Owl (*Strix occidentalis occidentalis*)

Issue Statement

California Spotted Owl is a long-lived and highly territorial species found in the mixed-conifer and oak woodland forests of the western Sierra Nevada and the southern coast range of California. California Spotted Owl is considered a species of special concern in the state of California, but unlike the northern and Mexican subspecies, is not federally listed. Studies on habitat use and life requirements of the California spotted owl universally concluded that it is a habitat specialist, which selects stand characteristics associated with old growth or mature forests for nesting, roosting and foraging.

NatureServe lists the population as declining 10-30 percent in the short-term, and 25-50 percent in the long term:

> A study of population dynamics of California spotted owls from four locations in the Sierra Nevada and one location in southern California (San Bernardino Mountains), spanning the years 1986-2000 overall,

found suggestive but not conclusive evidence of an overall population decline (Franklin et al. 2004).

"Demographic data collected in and around Lassen National Forest in northeastern California indicated an annual rate of decline in the territorial population of 9 percent per year over the period of study (1990-1999) (Blakesley et al. 2001). (NatureServe 2011)

The population of owls has been monitored on four study areas in the Sierra Nevada over the last 20 years. The results of the three demographic studies on national forests in the Sierra Nevada confirm the existence of a decline in the population over the last 20 years (Keane et al. 2011, Guitierez et al. 2012, Keane 2012, Munton et al. 2012, Scherer et al. 2012). Results from the single study in the Sierra Nevada on national park land indicate that the population is stable to increasing (Id.). Sierra Forest Legacy joined several other environmental groups in submitting a petition for federal listing of the sub-species under the ESA with the U.S. Fish and Wildlife Service on September 1, 2004. On May 23, 2006, the U.S. Fish and Wildlife Service (USFWS) announced that listing the species was not warranted. Citing unpublished data provided by the U.S. Forest Service, the USFWS concluded that wildfire posed a far greater risk to spotted owl populations than did the current timber harvest standards on public and private land in California. At that time, the USFWS found that "the best available data indicate that survival of spotted owl populations in the balance of the State of California (the Sierras) has been improving at the population level…We expect this trend to continue as the Forest Service in the Sierras implements its fuels reduction strategy that includes protections for the spotted owl and its habitat" (Federal Register, Vol. 71, No. 100, p. 29901). Contrary to this finding, populations have declined in three study areas within the Sierra Nevada during the time that the Forest Service has been implementing its fuels reduction strategy; there has not been an improvement at the population level. Further, the population in the San Bernardino area essentially has been extirpated. The status and trends for spotted owl are significantly worse today than when the listing determination was made in 2006.

Distribution and Ecology

Nesting Habitat

Spotted owls nest primarily in Sierran mixed conifer forests (Verner et al. 1992a). They use platform structures such as broken tops of trees or cavities and occasionally will use brooms on branches or old nests left by other species (Id). Between 20-30 percent of spotted owls in the Sierra Nevada nest in oaks occurring in mixed conifer, oak woodland and riparian areas (Gutiérrez et al. 1992, LaHaye et al. 1997).

The US Forest Service EIS for the 2001 SNFPA cites six studies, most of which are found in Verner's 1992 technical report which summarize spotted owl nesting habitat preferences as follows:

- two or more canopy layers
- dominant and co-dominant trees in the canopy averaging at least 24" dbh
- 70-95 percent total canopy cover (including hardwood component) (see also: Bias and Gutiérrez 1992, Moen and Guteirrez 1997, Steger et al. 1997a, pg. 30, Steger et al. 1997b, pg. 357, North et al. 2000, Bond et al. 2004, Blakesley et al. 2005, Gallagher et al. 2008, Keane 2008).
- higher than average numbers of very large, old, trees with high crown volume
- higher than average levels of snags and downed woody material

The research cited above indicates that dense canopy cover and large, old conifers and oaks are key components in spotted owl nesting and roosting habitat. On the Lassen NF, nest stands contained large trees (more than 24" dbh); these areas were selected more frequently for nesting relative to their abundance in the areas. Stands dominated by medium sized trees (11-24" dbh) were used with disproportionately low frequency compared to their availability (Blakesley et al. 2005, pg.1559). Keane (2008) reported 53 percent of nest sites were located in CWHR 5M, 5D and 6 habitat, indicating a preference for large trees and moderate to dense canopy.

Canopy cover in nest stands averaged more than 70 percent in most studies, again pointing toward an association with dense, mature conifer stands. Blakesley et al. (2005) reports that canopy cover at nest sites is "virtually always more than 80 percent (pg. 1560). Keane (2008) reported an average of 64 percent canopy cover. The difference in canopy cover at nest sites might indicate a range of preferences by owls, or may indicate differences in techniques used to measure canopy cover. Nonetheless, both measurements are consistently high. Roosting habitat is similar to nesting habitat, typically consisting of 70-75 percent canopy cover (Bias and Gutiérrez 1992, Verner et al. 1992b).

Spotted owl nest sites also contain elevated levels of snags and downed wood. Steger et al. (1997a) reported 12 large snags per acre at nest sites in the Southern Sierra. The 2007 Plumas Lassen Administrative Study reported that coniferous nest sites were characterized by 7.4 snags per acre. Snag density averaged 153.5 m3/ha in another Southern Sierra study (North et al. 2001). Current USFS snag retention guidelines of 4 snags per acre appear inadequate because they do not protect the average number of snags in nest stands.

Nest tree sizes vary somewhat, but mostly belong to the largest size classes across the Sierra. Nest trees in the Sierra Nevada averaged 45" dbh (Blakesley 2003, Steger et al. 2997). Riparian/ hardwood nest trees are usually smaller than conifers on average at 29" (Gutiérrez et al.1992). Approximately 90 percent of nest trees on the Lassen National Forest were more than 30" dbh (Blakesley et al. 2005).

Understory forest structure may be important to spotted owl breeding habitat as well. Research on the Eldorado National Forest found that 35 percent of the basal area of all trees at nest sites (110 ft.2/a out of 309 ft. 2/a) was in size classes 20" dbh and smaller (Verner et al. 1992a).

Table A-10. California spotted owl nesting habitat associations. (n/r = not reported)

Reference	Canopy Cover	CWHR Type	Snag Density	Downed Wood	Basal Area
Bias & Gutiérrez 1992	89%	n/r	n/r	n/r	n/r
Gutiérrez et al. 1992	40-100%	45% nest stands in M5M, M5D	n/r	n/r	n/r
Verner et al. 1992a (p.91) Nest Stand Records	75% in conifer stands	n/r	n/r	n/r	n/r
Verner et al. 1992a	70% mixed conifer	n/r	30-55 ft^2/a	10-15 tons/a	185-350 ft^2/a
Steger et al. 1997	90%	n/r	24/ a	n/r	67-75 m^2/ha
North et al. 2000	76%	n/r	153 m^2/ha	n/r	n/r
Bond et al. 2004	77%	M4M, M4D, M5M, M5D	n/r	n/r	n/r
Blakesley et al. 2005	>70%	$\geq$ 4M	n/r	n/r	n/r
Chatfield 2005	30%-70%	n/r	n/r	n/r	n/r
Seamans 2005	70%	n/r	n/r	n/r	n/r
Keane 2008	64%	4M, 4D, 5M, 5D, 6	7.4/ a		260 $ft.^2$/a

Foraging Habitat

Less information exists as to the foraging habitat preferences of spotted owls. Foraging habitat is more difficult to characterize than breeding habitat for several reasons. First, the habitat appears more variable. Second, when owls are away from the nest, it is more difficult to distinguish foraging versus other behavior. Nonetheless, spotted owls are still associated with older forests in foraging studies. Stands preferred by owls for foraging have (USFS 2001):

- at least two canopy layers
- dominant and co-dominant trees in the canopy averaging at least 11” dbh
- at least 50-90 percent canopy cover
- higher than average levels of snags and downed woody material

The average home range size for spotted owl in the Sierra Nevada is 4,200 acres and includes wintering as well as breeding habitat (Zabel et al. 1992). Home range may vary by latitude and elevation. Average home ranges on the Sierra National Forest in the Southern Sierra were approximately 2,500 acres (Verner et al. 1992a). Breeding territories were delineated in the northern Sierra at 2,000 acres (Blakesley 2005), in the central sierra at 988 acres (Seamans 2005) and 1,168 acres (Chatfield 2005). The USFS protects breeding home range areas of different sizes according to their location in the Sierra. In the northeastern Sierra, Home Range Core Areas (HRCAs) are 2,400a. The northern and central Sierra forests set aside 1,000 acres for each PAC. In the Southern Sierra, HRCAs are 600 acres. The breeding core area is about 20 percent of the home range (2001, V.3, Ch.3, pt.4.4, pg75).

The primary prey species for spotted owl in mid to high elevations in the Sierra Nevada above 4,000-5,000 feet are flying squirrels (Verner et al. 1992a). Spotted owl diet on the Lassen National Forest is comprised of 61 percent flying squirrel. Southern Sierra owl diets were also 61 percent northern flying squirrel (North et al. 2000). Woodrat are also an important prey species at mid- and lower elevations, providing more of spotted owl energy requirements than flying squirrel (Verner et al. 1992a). Oak woodland owl diet is 80 percent woodrat and these owl territories are smaller and closer together, perhaps because of prey availability (North et al. 2000).

Table A-11. California spotted owl foraging habitat associations. (n/r = not reported)

Reference	Canopy Cover	Snag Density	Downed Wood	Basal Area
Call et al. 1992	>40%	n/r	n/r	n/r
Gutiérrez et al. 1992	50-90%	15-30 ft^2/a	10-15 tons/a	180-220 ft^2/a
Zabel et al. 1992	>40%	n/r	n/r	n/r
Blakesley et al. 2005	>40%	n/r	n/r	n/r
Chatfield 2005	>70%	n/r	n/r	n/r
Gallagher et al. 2008	50-60%	n/r	n/r	n/r

Threats

Risk factors to spotted owl distribution and abundance include habitat loss, stand replacing wildfire, disease, climate change, drought, barred owl invasions, nestling survival, residential development, recreation, and disturbance (Verner et al. 1992a, Blakesley et al. 1999, Franklin et al. 2000, USDA Forest Service 2001, Anthony 2004).

a) Habitat Loss**:** Extensive loss of habitat has occurred throughout the spotted owl's Sierra Nevada range (Verner et al. 1992a). Logging since the turn of the century has resulted in a reduction in the amount and distribution of mature and older forests and specific habitat elements such as large trees, snags, and downed logs used for nesting and foraging by spotted owls (Verner et al. 1992a, Laudenslayer 1990, McKelvey and Johnston 1992). Much of the current concern regarding the sub-species population trends is focused on the effects of vegetation management on the distribution, abundance and quality of habitat.

Habitat loss has been linked to decreased reproductive output, decreased adult survival and an increase in territory abandonment. Seamans (2005) associated habitat loss with decreased survival. Another study by Blakesley et al. (2005) also showed a positive relationship between site occupancy, survival probability, reproductive output and nest success with presence of quality nesting habitat.

Even relatively small scale habitat loss in spotted owl territories is linked to owl emigration and decreased territory colonization. Verner et al. (1992a) and Moen and Gutiérrez (1992) found that spotted owls are sensitive to relatively small scale stand alteration within breeding territories. Further, Seamans and Guitierrez (2007) found that alteration of more than 49 acres of mature conifer forest within individual territories was negatively related to territory colonization and positively related to the probability of breeding dispersal. In other words, if pockets of dense canopy cover and large trees aren't retained where they occur in territories, the owls are more likely to leave.

Forest Service projects consistently reduce habitat quality to the least amount of canopy cover (40 percent) considered by some as suitable for the owl (USFWS 2006). This leaves spotted owl habitat in a condition for foraging that is not favored by owls (Keane 2008).

b) Habitat Fragmentation**:** This is of concern on the Lassen NF, Tahoe NF, Eldorado NF and Stanislaus NF because there are large inclusions of non-federal lands, including Sierra Pacific Industries, that pose uncertainty associated with maintaining intact nesting habitat and a well-distributed spotted owl population and (Verner 1992a, USDA Forest Service 2001).

c) Wildfire**:** High-severity wildfire has been identified as a threat to spotted owl habitat. Large stand replacing events can significantly alter habitat conditions. Resident birds have been known to leave severely burned landscapes; however, since these areas were also salvaged logged it is difficult to determine the specific cause for post-fire movements (Keane 2010).The USFWS identified wildfire as the most significant threat to spotted owl in the Sierra Nevada (USFWS 2006). The 12-month finding reports varying impacts of wildfire on spotted owl habitat. The agency assumed fires generally have a negative impact on owl habitat (Ibid) and concluded that they consider risk from catastrophic fire to be a far greater concern than any other threat evaluated (Ibid).

Several studies have identified the use of burned landscapes by nesting and foraging owls. Based on data from all three spotted owl subspecies, Bond et al. (2002) hypothesized that non-catastrophic "wildfires may have little short-term impact on survival, site fidelity, mate fidelity, and reproductive success of spotted owls. Further, prescribed burning could be an effective tool in restoring habitat to natural conditions with minimal short-term impact on resident spotted owls." Bond et al. (2009) used radio telemetry to assess owl use patterns in a burned landscape that was not salvaged logged. This study found higher than expected owl foraging in high-severity burn areas. Roberts et al. (2011) found owls use forests that burned at all severities and concluded that "low to moderate severity fires, historically common within montane forests of the Sierra Nevada, California, maintain habitat characteristics essential for spotted owl site occupancy." These studies indicate that wildfire as a general matter does not adversely impact owl habitat use of occupancy and in some cases owl use of post-fire landscapes may be enhanced.

***d) Nestling Survival*:** Late winter and early spring storms threaten spotted owl nesting success (Seamans 2005, Franklin et al. 2000, North et al. 2000, Forest Service 2001). Alteration of canopy cover can remove important thermal cover and shelter from elements vital to juvenile survival (North et al. 2000).

e) Breeding Habitat Disturbance: Disturbance from recreation activities may interfere with owl nesting success.

***f) Barred Owl*:** This species has been shown to out-compete spotted owls for nesting habitat in Washington and Oregon (Anthony et al. 2004). The ongoing decline of Northern spotted owl on the California coast was hypothesized to be largely a result of barred owl expansion into Northern spotted owl range over the past 15 years. The species is experiencing a rapid range expansion in the Sierra Nevada. There have been 41 detections on barred owl on the Plumas and Lassen NF (Keane 2008). Barred owls and sparred owls (barred-spotted hybrid) have also been detected on the Lassen, Plumas, Eldorado, Stanislaus and Sequoia National Forest to the south (personal communication, J. Keane).

***g) Disease*:** The effect of West Nile virus on owl populations is uncertain at this time because the disease was only recently detected in the Sierra Nevada (summer 2005). It is expected to have a 100 percent mortality rate in infected spotted owls (J. Keane, personal communication. June, 2004).

***h) Prey*:** Species reductions from impacts to duff and topsoil layers, snag density, reduction in large, old trees (Verner et al. 1992a).

The California spotted owl range encompasses part of California and possibly northern Baja California, from southeastern Shasta County south through the Sierra Nevada to Kern County; Coast/Peninsular Ranges from Monterey County to San Diego County; possibly the Sierra San Pedro Martir in northern Baja California. The USFWS estimated there were 1,400 territories in the Sierra Nevada on public land (USFWS 2006).

Spotted owls are characterized as late-seral stage closed canopy forest specialists (Bias and Gutiérrez 1992, Gutiérrez et al. 1992, Seamans 2005). They are associated with complex forest structure including greater canopy cover, basal area, snag density, and presence of large (more than 35.4") trees compared to average Sierran forest conditions (Gutiérrez et al.1995). They occur between 1,000' to 7,700' in the Sierra Nevada, and at higher elevation at the southern end of their range (Verner et al. 1992b). Most (86 percent) spotted owls nest between 3,000'-7,000' (Id).

Desired Condition

- Population trends throughout the Sierra Nevada are stable or increasing.
- Territories contain high quality habitat described in Table 1 and 2 with large, multi-storied trees, dense canopy cover, and sufficient downed wood and snags.

- Occupied habitat is managed 1) to support successful reproduction and survival; 2) to maximize suitability at multiple scales; and 3) for desired old forest conditions in the short and long term.

Objectives

- Maintain and enhance existing spotted owl habitat.
- Manage fuels and stand density in occupied habitat without compromising mid-sized and large trees in stand.
- Design vegetation management to retain and enhance habitat elements that characterize high quality nesting and foraging habitat.
- Vegetation management and other activities maintain owl occupancy

Conservation Measures

- Follow the recommendations for vegetation management in this conservation strategy, including limits to timber harvest, provisions for understory vegetation, large wood and large snags, and establishment of protected activity centers (PACs) and home range core areas (HRCAs).

Table A-12. Land allocations specific to California spotted owl conservation.

Land Allocation	General Description	Management Objective
Protected Activity Center (PACs)	Designation around known nesting sites for California spotted owl (300 acres) and great gray owl (50-200 acres). Inclusion in PAC of area within 300 feet of structures is avoided.	Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy
Home Range Core Area (HRCA)	Area around California spotted owl nest site and including the PAC. Size ranges from 600 acres to 2,400 acres depending on location in the Sierra Nevada.	Provide for high quality foraging habitat near to nest stands. Manage for low risk of loss of occupancy

- Use managed fire to the maximum extent possible to create variability in forest structure.

Management of Occupied Spotted Owl Habitat (PACs and HRCAs)

- In the Community Zone, the first priority is to meet fuels objectives to protect public health and safety followed by meeting spotted owl habitat objectives. Removal of trees larger than 16”-20” dbh can rarely be justified for fuels reasons (North et al. 2009).

- Outside the Community Zone (0.25 mile buffer around communities and infrastructure), spotted owl management in PACs and HRCAs is the first priority. Other objectives are only appropriate when it can be demonstrated in an the restoration plan that spotted owl objectives for maintaining and enhancing suitable habitat can be met. Removal of trees larger than 16”-20” dbh can rarely be justified for fuels reasons (North et al. 2009).

- Retain suitable structures for nesting such as large trees with broken tops, cavities, platforms and other formations (North et al. 2009).

- Retain all snags in PACs and HRCAs except to address imminent hazards to human safety (Id., p. 22; USFS 2001). Retain 8 snags/ acre >15"dbh, or a minimum of 20 ft^2/acre outside PACs (Verner et al. 1992b, Pg. 22). When snags need to be removed for human safety, cut and leave snags in place on ground. Consider topping snags with >15' sound trunk; leave top and trunk on site. Consider flagging off avoidance areas where hazardous snags occur in units to protect worker safety and retain snags.

- Maintain existing breeding habitat (i.e. >70 percent canopy cover) key to spotted owl survival. Design treatments to maintain average canopy cover for spotted owl territories, not minimal thresholds for survival. Land managers in the SN region should retain forest stands dominated by large trees with canopy cover >70 percent and minimize the amount of area unsuitable to California spotted owl within [494 acres] 200 ha surrounding spotted owl site centers to promote site occupancy and increase California spotted owl reproductive output. Results from Blakelsy et al. (2005) suggest that within owl core areas (814ha) increases in the availability of habitat used by California spotted owl for nesting, roosting and foraging will increase owl survival.

- Manage spotted owl habitat at multiple scales:
  - At the watershed scale, minimize gaps in spotted owl distribution by avoiding treating adjacent PACs in the Community Zone as a means to limit con-specific attraction and allow recolonization of suitable habitat. Maintain habitat connectivity between territories and watersheds. Old Forest-Connectivity (OFC) areas should be managed to maintain connectivity between owl territories at this scale.
  - At territory scale, minimize fragmentation of habitat and maintain or enhance high quality habitat (see Tables A-1- and A-11).
  - At stand scale, maintain multi-story habitat around roost and nest locations and promote key stand structure throughout including clumps of large trees, multi-layered canopy, nest platform sites, large snags, and downed wood.

- Conduct vegetation treatments in no more than 10 percent of the total number of owl PACs per decade. Track PAC entry for vegetation management annually by watershed. Include in the calculation of "treatment" any activity where suitable habitat is removed: severe wildfire, severe managed fire, mechanical activity, etc.

- Focus thinning on firs and cedars. Avoid thinning pines except in plantations. Avoid thinning hardwoods (North et al. 2009).

- Prohibit mechanical treatments within a 500-foot radius buffer around PAC activity centers (modified from USFS 2001).

- Maintain a limited operating period (LOP) from March 1- August 15 prohibiting activities within approximately ¼ mile of the PAC boundary during the breeding season unless surveys confirm that spotted owls are not nesting. The LOP can be reduced to ¼ mile from the active nest site, if known. The LOP applies to all mechanical activities, including road repair, motorized recreational events, increased haul truck traffic on roads, etc. unless a biological evaluation documents that such projects are unlikely to result in breeding disturbance. Considering intensity, duration, timing and specific location. Where a biological evaluation determines the nest site will be shielded from planned activities by topographic features that minimize disturbance, the LOP buffer may be reduced (modified from USFS 2001). The LOP may be waived to allow for early season prescribed burning in up to 5 percent of the PACs on a national forest per year.

Management of Suitable Unoccupied Spotted Owl Habitat (CWHR 4M, 4D, 5M, 5D & 6 stands)

- Only remove intermediate sized trees 20-30" dbh when they are shade-tolerant and on mid or upper slopes (North et al. 2009) when high quality owl habitat can still be protected.

- Assess habitat value of CWHR 4M and 4D habitat with a site specific analysis that is supported by stand exam data as part of environmental review for each project. Avoid treating CWHR 5M and 5D for reasons other than to meet Community Zone fuels objectives or to allow managed fire.

- Retain suitable structures for nesting such as large trees with broken tops, cavities, platforms and other formations (North et al. 2009).

- Apply stand structure concepts described in the structural diversity section of this conservation strategy.

- Conduct surveys in compliance with the Pacific Southwest Region's survey protocols during the planning process when proposed vegetation treatments are likely to reduce habitat quality in suitable California spotted owl habitat with unknown occupancy. Designate California spotted owl protected activity centers (PACs) where appropriate based on survey results (USDA Forest Service 2004).

Other Recommendations

- Continue the owl demographic studies until the results from the habitat analysis are completed and a proposal for future monitoring has been endorsed by owl scientists and adopted by Region 5 of the Forest Service.

- Assess the impact of applying North et al. (2009) to forest management in the Sierra Nevada for spotted owls (North et al. 2009). Determine the scale at which heterogeneity benefits spotted owls. For example, evaluate need for ¼-1 acre patches of multistory stand structure in a treatment unit vs. leaving 15-25 percent of units untreated, as specified in the 2001 Forest Plan Amendment. Summarize and apply all relevant spotted owl research conducted since the interim guidelines for California Spotted Owl management was released in 1993.

- Issue regional guidance for analyzing vegetation management impacts to spotted owls and their habitat at multiple scales (i.e. 300 acre PAC, 500 acre nest core, and 1,000 acre HRCA).

- Modify regional guidance for stand exams to detect small inclusions of residual old forest shown to be essential to spotted owl survival (Bias and Gutiérrez 1992, Gutiérrez et al. 1992, Verner 1992a, LaHaye et al. 1997, Moen and Gutiérrez 1997, North et al. 2000, Chatfield 2005, Blakesley et al. 2005, Seamans and Gutiérrez 2007).

- Monitor barred owl invasion in the Sierra Nevada. Evaluate options for protecting spotted owls in the Sierra Nevada based on extent of invasion and outcome of experimental removal done by Oregon Fish and Wildlife. If aggressive action is proposed, it should be implemented as soon as possible.

- Determine long term impacts or benefits of the range of wildfire effects and post-fire management on spotted owls (Bond et al. 2009).

- Determine how forest structure and composition varied by topographic feature under an active fire regime in the Sierra Nevada (North et al. 2009).

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Great Gray Owl (*Strix nebulosa*)

Issue Statement

The California great gray owl population is estimated at only 100-200 individuals (Winter 1980, Hull et al. 2009, Keane 2010), raising concern over long-term population survival. Hull et al. (2009) estimated California's effective population size to be 14 breeding individuals, indicating a significant and recent population bottleneck (Id). At such low numbers, the population is vulnerable to inbreeding as well as stochastic events such as disease, uncharacteristic wildfire, and unmonitored grazing prevalent in breeding territories on Forest Service land (Hull et al. 2009). The Forest Service PSW research station recently began a demography study on the Yosemite population.

Distribution and Ecology

The breeding range of great gray owls in the United States includes portions of Alaska, the Cascades, Sierra Nevada and Rocky Mountains, as well as portions of Minnesota, Michigan, Wisconsin, and New York (Verner 1994). Although primarily a boreal species, California's great gray owl population, which is centered in Yosemite National Park and is entirely located in the Sierra Nevada Mountains, is the southernmost population in the U.S. The Sierra Nevada population has been determined to be a separate subspecies, genetically distinct from the Cascades and other populations (Hull et al. 2010).

Sierra Nevada great gray owls are generally associated with dense mixed conifer, red fir, or lodgepole pine forests, and adjacent montane meadows from approximately 2,500 to 9,000 feet in elevation (Greene 1995). Winter downslope movement occurs between November and April to an average of 4,000 feet in elevation (range was 2,300- 5,500 feet) (Jepsen 2009). Great gray owls prefer to forage in open areas, such as open forest and meadows, and use the scattered trees of the forest margin to perch and search for prey. They have also been observed foraging in clear-cuts and plantations, although prey density is generally lower in these areas (Greene 1995). Burned areas are thought to provide early-seral 'meadow surrogate' habitat with high rodent densities. New owl territories can be established within 5-10 years following a large fire (Roy Bridgman, personal communication).

The great gray owl's primary food source is meadow-dwelling rodents, especially pocket gophers and voles, but it will occasionally eat birds (Johnsgard 2002, CDFG 2010). Although gophers are more abundant in meadows of the Sierra, their fossorial (underground) habit may limit their value as prey for owls (Greene 1995, Winter 1986). Gophers may be sufficient to maintain non-breeding individuals when the more cyclical vole populations are low in numbers, but vole abundance and suitable habitat correlates are among the best predictors of great gray owl presence and reproduction (Id).

In the Sierra Nevada, great gray owls nest in broken-top trees and cavities near meadows (Bull and Henjum 1990, Winter 2005). Great gray owls require mid to late succession forest to nest (Bull et al. 1988). Nest trees are typically greater than 24 inches diameter at breast height (dbh), and nest height can range from 25 to 72 feet (CDFG 2010). This species sometimes use nests built by other raptors, particularly goshawks, and will also use artificially constructed platforms (Bull and Henjum 1990). Canopy cover in nest stands ranges from 65-100 percent and provides protection from potential predators such as great horned owls and goshawks and for thermal cover from the sun, an important factor for this boreal species at the southernmost extent of its range (Beck and Craig 1991). Removal of over 50 percent of forest cover may eliminate great gray production (Id). This may be because goshawks are also eliminated from the area and are no longer able to provide nest structures, or because lower canopy cover makes owls vulnerable to inclement weather during nesting and to predation.

Breeding in the Sierra Nevada begins in late February with the peak of egg-laying in mid-April through late May. Incubation takes 28-29 days (Johnsgard 2002) with fledging after a minimum of 21-28 days (CDFG 2010). The young remain in the nest area until they are four to five months old (Johnsgard 2002). Fledged owls do not fly immediately, and spend a lot of time on the ground, where dense vegetative cover and leaning trees for climbing are important (Beck 2005, Winter 2005).

Based on the studies in California, breeding home ranges average between 0.16-1.75 mi^2 and most of the owl's time is spent in the 600-foot forested buffer zone (Winter 1986, Sears 2006, Stermer 2010). Owl activity is concentrated within 900 feet of the meadow and forest-edge habitat during breeding (Winter (1982). He also found 90 percent of activity within 800 feet of meadow edge, and Greene (1995) similarly found owl nests within 880 feet of meadow edge. Persistently occupied meadows in the Sierra Nevada are typically over 25-30 acres in size and offer high quality meadow vegetation throughout the breeding season (Winter 1982, Winter 1986, Greene 1995, Hayward and Verner 1994); however, many owls nest along meadow complexes that are much larger, i.e., 100-400 acres, possibly because of lower quality of meadow vegetation and associated prey.

Numerous studies have documented predation on great gray owls. Northern goshawks and great horned owls frequently prey on juvenile great gray owls (Duncan 1987). Bull and Henjum (1990) also report many juveniles are killed by avian predators. High canopy cover and multi-story canopy near the nest is thought to reduce predation risk.

Beck and Winter (2000) recommend maintaining a minimum of 6 snags/acre, 70-100 percent canopy cover, and 5-10 inches of residual meadow cover in protected activity centers (PACs), i.e., the 50-acre area surrounding a nest site. Dead and downed wood should be left for cover for voles. Burning that destroys this downed material should be avoided (Bull and Henjum 1990).

Threats

Habitat degradation is a management concern for the great gray owl. The loss of large trees needed for nesting, the effects of conifer encroachment, and overgrazing to meadows have likely reduced the population from historical numbers (Winter 1986, Hayward and Verner 1994). Three quarters of nests in one Oregon study occurred in unlogged stands (possibly because of large tree availability) (Bull et al. 1988). Urbanization in the owl's winter range is another source of habitat loss in California. Approximately 48 percent of the owl's wintering habitat area is in private ownership, with 35 percent on U.S. Forest Service lands, and 14 percent on

National Park lands (Jepsen 2009). Development trends show that by 2040, 60 percent of wintering habitat in the privately owned lands would be developed, which equals development of 28 percent of the owls wintering habitat (Id).

Lastly, adult owl mortality is alarmingly high for such a small population. Seven out of twelve birds with radio telemetry died in a CDFG study between 2005-2007 (a 58 percent mortality rate). Autopsies found lesions on the heart or throat, possibly from trichomoniasis (Stermer 2010). Great grays are also thought to be extremely vulnerable to West Nile virus (Keane, personal communication). Auto collisions are another significant source of adult mortality. Approximately twenty-six great gray owls have been reportedly hit by vehicles in the greater Yosemite area between 1955-2005, including at least twelve in Yosemite since 1985 (Maurer 2005)

Desired Condition

- Great gray owl populations are stable or increasing.

- Great gray owl protection and conservation is a priority in the region. Because of the rarity and threat faced by this bird, conservation of this species takes precedent over resource management,(besides fuels reduction to address public health and safety).

- Meadow habitat provides high levels of the preferred prey species.

- Meadow vegetation and stream course condition are restored to the best possible functioning condition in all great gray owl territories.

- The autecology of the Yosemite great gray owl population is well understood.

Objectives

- Enhance and restore the meadow environment; prey habitat is the highest priority in meadows and meadow complexes with current and historic occupancy.

- Consistently manage meadows and meadow complexes associated with great gray owl breeding detections. Meadows and meadow complexes should be managed to provide for suitable great gray owl breeding habitat if birds are detected at meadow, regardless of the boundary of the protected activity center (PAC).

- Manage the forested areas of PACs for dense understory within 500 feet of any nest sites. Within the Community Zone, manage surface and ladder fuels outside 500-foot nest buffer. Do not reduce canopy cover of trees over 20” as these trees rarely contribute to extreme fire behavior (North et al. 2009). Outside of defense zone, manage forested area for maximum canopy cover, multistory canopy, and large snags.

Conservation Measures

- Conduct surveys following accepted protocols (Keane et al. 2011) for great gray owl prior to all vegetation management affecting mature forest within 1,000’ of the edge of a meadow that is 15 acres or greater in size, activities that affect meadows of this size directly such as grazing, or post-fire activities within the species range. Revisit known territories and sightings in meadows affected by annual operating instructions (AOI) for grazing permits prior to approval of the AOI.

- Evaluate opportunities to create nest structures where they are limiting in suitable habitat.

Delineation of Protected Activity Centers (PACs)

- All units should delineate great gray owl PACs in the same manner to include the following (Beck 2001):
    a. Establish and maintain a protected activity center (PAC) that includes the forested area and adjacent meadow around all known great gray owl nest stands (USDA Forest Service 2001).
    b. While territorial occupancy (a pair, resident single, or sign such as a feather or pellet found during the breeding season) may be found without signs of nesting, it should be considered to indicate a nest territory, depending on the habitat. Nest stands may be defined by territorial occupancy because Great Gray Owls typically do not nest every year and occupancy status changes from year to year are not unusual.
    c. Include entire acreage of meadow margin (roughly a 200 yard zone of forest edge surrounding the meadow) be managed for nesting habitat. Note that historic nests have been found in inclusions of CWHR types 6, 5D, 5M, and 4D as small as 1/8 acre.
    d. Also include the meadow or meadow complex that supports the prey base for nesting owls (USDA Forest Service 2001). Delineate the entire meadow or meadow complex breeding owls are detected at. In total, 1,000 acres of forest and meadow may be needed to sustain a pair. Delineate great gray owl PACs to encompass entire meadow the nest site or detection is associated with. Include nearby stringer meadows or other possible foraging areas such as recent burns, failed plantations, grasslands, etc. The percent of meadow depends on habitat condition. Habitat condition can vary greatly from site to site and from year to year. Within territories, pellets/feathers/fecal spots/sightings/telemetry locations are typically found throughout the meadow or meadow complex most adjacent to a nest stand. The size of an adjacent meadow or meadow complex varies greatly for the species from 25 acres up to and including meadows hundreds of acres in size. Note that meadows that provide suitable foraging habitat at the lower end of range of meadow sizes (i.e. 25-30 acres) are typically in very high ecological condition (e.g., Crane Flat, Yosemite National Park).
    e. Delineate a minimum of 50 acres (USDA Forest Service 2001) and up to several hundred acres (Beck 2001) of the highest quality nesting habitat.

Table A-13. Land allocations specific to great grsy owl conservation.

Land Allocation	General Description	Management Objective
Protected Activity Center (PACs)	Designation around known nesting sites for California spotted owl (300 acres) and great gray owl (>50 acres). Inclusion in PAC of area within 300 feet of structures is avoided.	Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy

Mechanical Operations in Forested Areas

- Retain all possible nest trees including all snags in PACs. If snags must be cut for safety, leave logs on site. Consider topping snags with sound base at least 15' high.

- Maintain 70-100 percent canopy closure in the forested areas of the PAC (Beck and Winter 2000).

- A 500-foot buffer around the nest trees should be managed to limit habitat alteration, i.e., no mechanical activity and limited hand work associated with controlled burning. Maintain the existing canopy cover in the immediate area of the nest trees, where nesting birds and fledging young are most likely to occur. Fledgling owls need multi-story vegetation and leaning trees to climb up off ground and for cover (Bull et al. 1988, Jon Winter, personal communication).

- Maintain a limited operating period (LOP) between March 1-August 15 within ¼ mile of a great gray owl nest stand or PAC boundary if the nest can't be located, unless surveys confirm birds are not nesting. The LOP applies to all mechanical activities, including road repair, motorized recreational events, increased haul truck traffic on roads, etc. unless a biological evaluation documents that such projects are unlikely to results in breeding disturbance considering their intensity, duration, timing an specific location. Where a biological evaluation determines the nest site will be shielded from planned activities by topographic features that minimize disturbance, the LOP buffer may be reduced. The LOP may be waived to allow for early season prescribed burning in up to 5 percent of the PACs on a national forest per year (modified from USDA Forest Service 2001).

- Limit additional recreational activities or developments such as roads or campgrounds in the PAC and areas within approximately ½ mile of the PAC and the associated meadow.

Meadow Management

- Exclude meadows associated with great gray owl PACs from grazing allotments and fence if necessary to exclude cattle. If grazing must occur, maintain stubble heights at a minimum of 12," measured at the end of the grazing season (USDA Forest Service 2001). Avoid grazing in the meadow prior to September.

- Enhance small stringer meadows in and around the PAC through conifer removal, grazing reduction, and limiting OHV or other recreational use.

- Maintain or enhance the condition of the streams associated with meadows in PACs. Set a high priority on the repair of gullies, head cuts, soil compaction, stream bank instability, and avoid grazing on riparian vegetation.

- Enhance meadow and riparian vegetation to support prey species in meadow such as voles. Control conifer encroachment into meadows. Conifers in the meadow provide perches for foraging, but can also shade and dry the meadow. Periodic thinning may be beneficial, but consider retaining tall stumps or girdling trees to retain perch values for areas where meadow is more than approximately 200' wide (Beck and Winter 2000).

- Fencing is valuable for controlling grazing, but may adversely affect owl movement. Where possible, remove unused fences from within and around the meadows.

Other Recommendations

- Convene a multi-agency and stakeholder group to evaluate opportunities to protect and restore great grey owl habitat on public and private land.

- Develop a conservation plan to address habitat needs and species management across all ownerships.

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Northern Goshawk (*Accipiter gentilis*)

Issue Statement

The northern goshawk (*Accipiter gentilis*) occurs throughout North America, from Alaska throughout Canada and the U.S., and into Mexico. Although it is a large raptor, the size of a red-tailed hawk, the goshawk is remarkably maneuverable on the wing, able to chase down prey in dense understory. This fierce hunter is also vulnerable to human activity. Logging threatens breeding and foraging habitat throughout the U.S., including the Sierra Nevada (Squires and Reynolds 1997, USDI FWS 1998, Andersen et al. 2005, Keane 2008, NatureServe 2012). For this reason, it is a Forest Service designated sensitive species in Region 5, a State Species of Special Concern. The goshawk is also ranked S3 by NatureServe in California.

The U.S. Fish and Wildlife Service (FWS) released a status review of goshawk in 1998 and announced that protection under the federal endangered species act was unwarranted. Recent examination of the status review by the academic and professional community (Andersen et al. 2005) as well as examination of how earlier research was misapplied to goshawk habitat management (Greenwald et al. 2005) has reinvigorated dialog about goshawk conservation. While goshawks are charismatic and renowned they also remain secretive and difficult to understand and manage for. Here, we present science-based management recommendations and summarize current knowledge of their habitat needs.

Distribution and Ecology

Elevation Range: Goshawks breed in the Sierra Nevada from about 2,400' to over 10,000' and on the east side. Birds living at higher elevations during breeding likely move down slope during winter (Keane 2008).

Habitat: Goshawks occur primarily in ponderosa pine/mixed conifer vegetation types on the west side of the Sierra Nevada. On the east side, they inhabit Jeffery Pine or ponderosa pine, and occasionally hardwoods such as aspen (Keane 2008).

a) Reproductive Habitat: The most consistent vegetative characteristic of goshawk nest sites is dense canopy closure (Zeiner et al. 1990, Squires and Reynolds 1997, Desimone and DeStefano 2005). Nest stands are typically characterized by high canopy cover on gentle to moderate slopes with an open understory (USFS 2001). When compared to random plots, stands preferred by goshawks for nesting and roosting (in west side vegetation types), are characterized by (Squires and Reynolds 1997, Hargis et al. 1994, Keane et al. 1999, Maurer 2000, USDA Forest Service 2001):

- Greater basal area than random plots
- Greater numbers of large live trees (trees > 24" dbh)
- Greater canopy cover (mean = 65 percent and 70 percent Keane et al. 2006, Maurer 2000)
- Higher than average numbers of very large, old, trees (mean = 17 trees/ac > 40" dbh)
- Open understory with significantly lower numbers of trees less than 12" in dbh

Possible explanations for goshawk affinity to closed canopy conditions include protection from predators, reduced exposure to cold or hot temperatures, increased food availability, reduced competition for nest location by other large birds (ravens, red-tailed hawks) (Andersen et al. 2005).

Breeding habitat has been studied at several different scales. It appears that goshawks need high canopy cover and old forest structure with minimal fragmentation at the 50, 120, and 420-acre scales. At the 50a stand scale, nest trees are the largest trees in a stand with dense canopy cover and open understory (Keane 2008). Goshawks typically nest in the lowest branches of a large tree, and they use an open understory to nest, perch and hunt (Id). Goshawks build multiple stick nests and can maintain up to eight alternate nests in one territory, sometimes in several different nest stands (Squires and Reynolds 1997). These alternate nests are important for land managers to find and protect even if they are unoccupied for years at a time (Andersen et al. 2005, Weber 2006).

At the 100-200 acre scale, persistence of active nest areas over time are associated with less than 50 percent old forest cover (Desimone and DeStefano 2005) and are inversely associated with forest fragmentation (Woodbridge and Detrich 1994). Reynolds et al.(1992) recommends maintaining at least 40 percent old forest cover at the 420-acre post-fledgling area (PFA) scale in Arizona. Whether these recommendations retain sufficient cover to sustain goshawks has not been determined (Greenwald et al. 2005).

Goshawk use of open areas for hunting at any scale is poorly understood. Therefore, management related questions persist, such as: how much old forest do goshawks need to survive and reproduce? And, do goshawks use or need open areas to hunt? Some studies document avoidance of open areas, while others document no preference during hunting (Reynolds et al. 2008). For example, breeding has been documented for several seasons following the die-off of trees affected by beetles near nest stands (Squires and Reynolds 1997). Perhaps some burned areas still provide old forest structure and an ephemeral pulse of resources goshawks can capitalize on for a few years. Because old forest cover has been greatly reduced throughout the Western U.S., it is important to protect old forest cover where it still exists until habitat needs are better understood (Greenwald et al. 2005).

The U.S. Forest Service in Region 5 protects 200 acres as goshawk breeding territories, but does not protect habitat at the 420 acre post-fledgling scale. Impacts of forest management on goshawk territories at this scale are unknown and represent a risk to the species (Keane 2008). We do know that goshawks select for old forest habitat at this scale to raise their young, so in light of this uncertainly surrounding forest management impacts, we recommend maintaining preferred breeding habitat at this scale as well.

b) <u>Foraging Habitat</u>: Foraging habitat preferences of goshawks are poorly understood, although limited information from studies in conifer forests indicate goshawks prefer to forage in mature forests (Squires and Reynolds 1997) with greater canopy closure and greater density of large (>40"dbh) trees relative to random plots (Hargis et al. 1994). Foraging habitat structure must allow a large bird ease of hunting near an open forest floor. Although controversy exists over management guidelines that identify goshawk foraging habitat as early seral areas of high prey density (Squires and Reynolds 1997), these associations were based on very little research (Squires and Reynolds 1997). Subsequent peer review supports the notion that goshawks forage in old forest and select foraging areas based on forest structure, not on prey availability (Andersen et al. 2005, Greenwald et al. 2005). Indeed, some of their key prey species are also associated with old forest such as Douglas tree squirrels.

Diet: Goshawks feed on a variety of birds and mammals. The following are important contributors to the biomass of their diet: Douglas tree squirrels, golden-mantled ground squirrels, Belding ground squirrels, Western gray squirrels, hares, rabbits, chipmunks, robins, flickers, Steller's jays (Keane 2008, Keane et al. 2006, Fowler 1988).

Reproduction: Goshawks have high mate and territory fidelity (Weins et al. 2006). Nest locations may alternate each year within one territory. A breeding pair may maintain up to eight alternate nests (Squires and Reynolds 1997). They are strongly sexually dimorphic with the females approximately 60 percent larger than males (Id). The larger females defend the nest and males provision nest (Ibid).

Goshawks usually begin breeding at three years of age and have one brood per season (Squires and Reynolds 1997). Courtship starts around mid-March and eggs are laid in late April. Eggs hatch one month later in late-May. By late June, juveniles are one month old and have adult feathers. Juveniles learn to hunt in the post-fledgling area through the fall. Prey availability is strongly limiting for juvenile survival (Wiens et al. 2006). Maximum life span is at least 11 years (Squires and Reynolds 1997).

Goshawk reproductive success is closely associated with tree squirrel populations (Keane et al. 2006, Wiens et al. 2006, Salafsky et al. 2007) and annual weather patterns, particularly late winter temperatures (Keane et al. 2006). Considering that tree squirrel densities follow the previous year's pinecone crop, the importance of old forests is underscored because older conifers tend to produce more abundant and frequent cone crops (Keane et al. 2006).

Predators: Goshawks are large and aggressive birds with few natural predators. The great-horned owl is one, although female goshawks are the same size and will attack a great horned owl to defend its nest. Interspecies predation is also documented (Squires and Reynolds 1997).

Home Range: Mean female breeding home range size on the west slope of the Sierra is 4,980a and 6,664a for males. Non-breeding home ranges are 13,776a for females and 20,317a for males (USDA Forest Service 2001). On the east side, mean female breeding home range is 3,310a and 5,928a for males (Id). Dispersal distances have been recorded up to 60 miles (NatureServe 2012).

Breeding home ranges are described as several core habitat areas including the nest areas and key foraging areas. Home ranges outside the nest areas are not defended and can overlap with other birds. However, goshawks are territorial and nests belonging to different territories do not occur closer than 1 mile from one another. This is helpful information for land managers to choose survey areas for new nests. If a known nest occurs within less than a mile of suitable habitat, then it can safely be assumed there is no new goshawk breeding territory in that area (Keane 2002).

Little is known about goshawk use of home ranges. In 2001, the Forest Service struggled with how to provide adequate habitat at this scale, and concluded that there is not enough information to determine if management guidelines for home ranges provide adequate habitat (Ch.3 pt. 4.4 pg 128). Currently, the Forest Service does not manage for goshawk at the home range or PFA scale.

Demography: Demography studies on goshawks are limited. In 1998 the U.S. Fish and Wildlife Service (FWS) completed a status review for the northern goshawk and announced its finding that there is "no evidence that the goshawk population is declining in the western United States…" and that in California "population data available…are inadequate to allow determination of any current trends in goshawk populations in California." (1998). The FWS finding raised significant concern in the professional and academic community, resulting in a technical review sponsored by the Wildlife Society and the Raptor Research Foundation (Andersen et al. 2005). Reviewers found that the FWS inappropriately and inaccurately estimated population trend, population growth rates, species distribution, habitat distribution and habitat trends (Ibid). In some cases, agency determinations were found to be speculative rather than evidence-based (Ibid). The status and distribution of goshawk populations, especially in California, remains largely unknown. Breeding populations occur in small numbers throughout northern California and the Sierra Nevada, but these small populations are vulnerable to any number of stochastic events and other threats (Id).

Threats

The following are likely to contribute to goshawk population instability:

Logging/ Habitat Loss: A primary conservation concern for goshawk is loss of breeding and foraging habitat due to logging throughout the U.S., including the Sierra Nevada (Squires and Reynolds 1997, USDI FWS 1998, USDA Forest Service 2001, Andersen et al. 2005, Keane 2008, NatureServe 2012). In southern Oregon, researchers tracked nest activity over a 20 year period and found that low occupancy rates by some territories was due to loss of nesting habitat from logging (Desimone and DeStefano 2005). In another study, territory occupancy is closely associated with patch size of old forest patch sizes at the nest stand scale (Woodbridge and Detrich 1994). Goshawks require old forest throughout their breeding territory and PFA in order to produce young.

Noise and Nest Stand Disturbance: Goshawks are extremely sensitive to noise and human presence in or near the nest stand during pair bonding, nest-building and incubation (Squires and Reynolds 1997, Keane et al. 2006). Nest failure has been repeatedly documented from research visits to nest areas before June (Keane et al. 2006). Even camping near nests can cause failure (Squires and Reynolds 1997). Noise and disruption associated with timber harvest operations (e.g., logging equipment, log truck traffic, road construction, timber cruising) can also cause nest failure even after nestlings have almost fledged in late June (Id). Unusually heavy road traffic or OHV use have the potential for similar negative impacts (USDA Forest Service 2001).

Population Size: Keane (2008) describes five areas of concern in California where goshawk extirpation is a risk due to range contraction or small breeding population. Three of these areas are located in the Sierra Nevada: east side pine zone, west side ponderosa pine zone and the Southern Sierra Nevada. In the first two pine zones, extensive logging has removed conifer habitat used by goshawks. In the Southern Sierra south of Yosemite National Park, goshawk sightings are limited and uncertainty exists as to the cause. Possible explanations include low survey effort in the area, low breeding densities, or a recent range contraction (Id). Rodenticide may also contribute (see item g below).

Nestling Survival: Weather patterns in conjunction with prey dynamics appear to be a primary factor affecting goshawk reproduction and survival. Prey availability is also key to fledgling survival during their first winter (Wiens et al. 2006). Late winter storms can cause nest failure for the year. If global climate change leads to a trend toward colder wetter springs and late season storms, it would also have the potential to negatively affect goshawk demography.

Urban Development: Development on the west slope often results in goshawk habitat loss and sometimes disturbance to nearby breeding territories. Recreation activities such as off-highway vehicles (OHVs) can also be a significant disturbance to breeding territories during the late spring and early summer (Keane 2008).

Falconry: Falconers are permitted to take goshawk nestlings from the wild by California Department of Fish and Game. This activity does not appear to threaten statewide goshawk numbers except on the east side Inyo National Forest where repeat harvest from only a few areas may jeopardize persistence of individual territories (Bloom et al. 1986, Keane 2008).

Rodenticide/ Poison: Raptors and other predators are vulnerable to rodenticides because they bio-accumulate in prey tissue. Second generation anti-coagulant rodenticides (e.g., D-Con) have been reformulated with greater lethality and potential for bio-accumulation than first generation poisons (e.g., strychnine).

Rodenticides are liberally used on marijuana plantations across the Sierra Nevada. Poison is poured all over grow sites and irrigation hose lines. Non-target effects have been documented in many wildlife species, including a close relative of the goshawk, the Cooper's hawk, as well as golden eagle, barn owl, red-tailed hawk, red-shouldered hawk, great-horned owl and a myriad of rare and common mammals. Impacts to goshawk are likely but presently unknown.

Desired Condition

- Goshawk populations are stable or increasing.
- Goshawk breeding and foraging are met at the appropriate spatial and temporal scales.
- Old forest cover is widespread and habitat fragmentation is limited.
- Prey species, such as squirrels and flickers, are abundant and sustain goshawks throughout their life cycle.
- Prey habitat such as older conifer and mixed conifer forests, large snags and logs, meadows, and riparian areas sustain a variety of rodent and bird prey eaten by goshawk.
- Goshawks are undisturbed by human activity during breeding.

Objectives

- Maintain existing nesting structures and nest tree recruitment (especially pine species).
- Maintain dense canopy cover and open understory structure throughout most of the post-fledgling area (PFA).
- Maintain forest structure for hunting and foraging throughout the PFA.
- Conduct landscape assessments to identify restoration opportunities to increase old forest cover and continuity.
- Limit disturbance to goshawks during breeding near nests.
- Monitor project-level responses of nesting goshawks to management treatments (Keane 2008). Conduct implementation and effectiveness monitoring for goshawk habitat on a project basis (US Fish and Wildlife Service 1998).

Conservation Measures

- Follow the recommendations for vegetation management in this conservation strategy, including limits to timber harvest, provisions for understory vegetation, large wood and large snags, and establishment of post-fledgling areas (PFAs) and limited operating periods.
- Use managed fire to the maximum extent possible to create variability in forest structure.
- Designate goshawk post-fledging areas (PFAs) of approximately 420 acres in size around nest sites.

Table A-14. Land allocations specific to northern goshawk conservation.

Land Allocation	General Description	Management Objective
Post Fledgling Area (PFA)	Area (420 acres) around northern goshawk nest stand. Delineated around all birds known to be nesting.	Manage for breeding and nesting; area intended to support fledglings. Mature forest, large tree structures (live and dead), open understories. See Appendix A for additional details on desired habitat conditions.

- Manage PFAs to maintain or enhance dense canopy cover, basal area, open understory, large old conifers, and snags, downed logs, riparian and meadow habitat for prey species (Salafsky et al. 2007) such as tree squirrels, ground squirrels, flickers, jays and robins.
- Maintain canopy cover in nest stands and post-fledgling areas at or above 60 percent to support goshawk reproduction and juvenile survival.
- Conduct mechanical treatment in PFAs only to meet fuels objectives. Retain large snags and downed trees on site as prey habitat.
- Conduct surveys in suitable habitat for goshawk prior to project planning and mechanical activity. Identify and protect all alternate nest sites as well as active nests. Surveys should extend 0.5mi outside project boundaries (Youtz et al. 2007).
- Vegetation treatments are conducted in no more than 5 percent per year and 10 percent per decade of the acres in goshawk PFAs by watershed and district.
- Restrict mechanical activities including recreation during the critical nesting and fledgling periods (March 1 through Aug. 15) within 0.25 mi. of nest stands. Restrict nest stand entries until at least June 1. Potentially disturbing activity includes mechanical equipment, unusual vehicle traffic, camping or parking areas, non-motorized traffic, etc.

Other Recommendations

- Review new research on goshawks with an expert panel and modify or add new goshawk management standards as recommended.
- Conduct radio telemetry studies to increase understanding of foraging habitat and prey use in both the breeding and winter periods (Keane 2008).
- Develop empirically derived habitat models to monitor change in habitat distribution and quality at home-range and landscape scales (Keane 2008).
- Conduct basic demographic research to understand how survival and reproduction are affected by interactions among habitat, prey, weather, and possibly disease such as West Nile virus (Keane 2008).
- Investigate rodenticide impact on goshawks in the Sierra Nevada.
- Establish and annually update and manage a statewide nesting record database for tracking distributional patterns and assessing conservation status across state, federal and privately managed lands (Keane 2008).
- Advocate that Calif. state EPA and federal EPA list the second generation rodenticides as “restricted use materials” so that they are not available over the counter at farm supply stores without a license and other regulatory oversight.

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Pileated Woodpecker (*Dryocopus pileatus*)

Issue Statement

Pileated woodpecker is a species of concern in the forests of the Sierra Nevada because it is an old-growth associate and snag-dependent species requiring large areas for territories, and is especially vulnerable to both local- and landscape-scale habitat alterations. Pileated woodpecker (*Dryocopus pileatus*) numbers are thought to be declining in the Sierra Nevada as a result of logging mature forests and cutting snags (Verner and Boss 1980, Harris 1982). Grinnell and Miller (1944) summarized the status of this species as "diminishing about commensurately with extension of lumbering operations." The availability of large snags and large decaying live trees necessary for nesting and roosting by pileated woodpeckers has declined in many areas as a result of forest conversion and timber management practices (Bull and Jackson 1995, Ferguson et al. 2001). In Eastern Oregon, where forests underwent extensive regeneration harvests, pileated woodpecker density dropped by 80 percent (Bull et al. 2007).

The pileated woodpecker is also a keystone species (Aubry and Raley 2002b). As primary cavity excavators, they create habitat for more than two dozen forest species and secondary cavity nesters (individuals that use cavities but do not create them) (Raphael and White 1984, McClelland and McClelland 1999, Bonar 2001, Aubry and Raley 2002a). They also facilitate heart-rot through their excavating and foraging activities and are the primary architects of snag development (Aubry and Raley 2002b).

Pileated woodpeckers require extensive forests containing large mature diseased trees and snags, dense forests, and a forest floor littered with decaying wood (e.g. Bull 1975, Schroeder 1982). Ideal habitat provides a relatively humid environment (such as streamsides) that can promote fungal decay and sustain the ant, termite, and beetle populations on which these birds feed. Pileated woodpeckers primarily eat carpenter ants excavated from dead or decayed sap- or heartwood (Bull et al. 1986) but they also eat a variety of beetles and other insects and smaller amounts of plant foods (less than 30 percent) (Beal 1911 in Zeiner et al.1988). The duration of decay states and size of tree are often correlated.

Population data such as the Breeding Bird Survey are not available with precision for pileated woodpeckers in the Sierra Nevada but existing data suggest a stable population (Sauer et al. 2011). Pileated woodpecker are ranked G5 (globally secure) by NatureServe, primarily due to the widespread distribution of pileated woodpecker in North America.

Distribution and Ecology

The pileated woodpecker is a widely distributed species and year-round resident ranging from northern British Columbia, across Canada to Nova Scotia, south through central California, Idaho, Montana, eastern Kansas, the Gulf Coast and Florida (Bull and Jackson 1995). The California range of the pileated woodpecker extends from the Oregon border in Siskiyou County, south in the Coast Range region to Sonoma, Marin, Santa Cruz and western Santa Clara Counties, and to Howell Mountain in Napa County. It ranges inland from the Mount Shasta and Lassen Peak region south throughout the Sierra Nevada to the Greenhorn Mountains in Tulare and Kern Counties (AOU 1998, Grinnell and Miller 1944, Small 1994). Small (1994) also reported occurrences of this species in Alameda and Contra Costa Counties. Although Grinnell and Miller (1944) considered it to be a fairly common resident, Small (1994) described it as a rare to uncommon resident.

Habitat Characteristics

In the western region of North America, the pileated woodpecker is almost exclusively found in mid- to late seral conifer-dominated forests (Mellen et al. 1992, Bull and Holthausen 1993). A research team studying pileated woodpeckers in the Lassen and Plumas National Forests concluded that canopy closure is the single best predictor of the presence of pileated woodpecker. Pileated woodpecker were found to be significantly more abundant in 1,000 acre Spotted Owl Core areas than elsewhere (PRBO 2007, 2008). However, research in Eastern Oregon found that canopy reduction from natural causes (insect outbreaks) did not affect pileated woodpecker density, as long as extensive logging and fuel reduction had not occurred (Bull et al. 2007).

Multiple studies identified old-growth or late seral forest as being important for the species (reviewed in Bull and Jackson 1995). Isolated large, dead trees amidst a younger forest may also be used for nesting (Bull and Jackson 1995). Nelson (1988) found pileated density was greater in forests over 80 years old with greater than 60 percent canopy closure. Stands at least 40 years old were preferred for foraging (Bull et al. 1992, Mellen et al. 1992).

Large snags are used for foraging, nesting, and roosting. The majority of nests are in large snags averaging 37 inches DBH with mean tree height of 108 feet (reviewed in Bull and Jackson 1995). Schroeder (1982) summarized two studies in the western United States, both of which reported the mean height of the nest tree as 92 feet. According to Schroeder's Habitat Suitability Index Model, optimum pileated woodpecker habitat contains 30 or more trees greater than 20 inches DBH per acre within a minimum of 320 acres; optimum canopy closure is 75percent or greater and stands with less than 25 percent canopy closure have no suitability for the species.

Some of the studies cited in the model document nesting pairs of pileateds in ranges as large as 600 acres. Average home range sizes of pairs in northeastern Oregon and western Oregon ranged from 1,006 acres to 1,181 acres, respectively (Bull and Jackson 1995). In conifer forests of northeastern Oregon, territories ranged from over 320 to 600 acres (130 to 243 ha); minimum density of 13 pairs was 1 pair per 1620 acres (656 ha) (Bull and Meslow 1977 cited in Verner and Bos 1980). Bull and Holthausen (1993) reported territory size for breeding pairs in the Blue Mountains averaged 407 ha (1006 ac) and was considered an adequate size to manage for each breeding pair in that region. Long term studies in the region (>30 years) suggest that the same home ranges can be managed for pileated woodpeckers for decades, if large snags and logs exist or are retained (Bull et al. 2007).

Pileated woodpeckers rarely re-use cavities from year to year, and eleven or more roost cavities are used within a year by individual birds (Bull et al. 1992). Bull et al. (1992) found 95 percent of roost cavities had a hollow interior created by decay rather than excavation. In Oregon and Washington, the mean height of the nest hole ranged from 49-125 feet above the ground (Bull and Jackson 1995, Schroeder 1982).

Pileated woodpeckers occupy the same home ranges for up to 30 years and possibly for two to four generations. Density of pileated woodpeckers decreased 80 percent after extensive tree harvesting. Pileated reproductive success appears to be closely tied to the amount of unharvested, closed-canopy stands, and reproductive failure appears tied to the amount of harvested stands. High tree mortality is not detrimental to pileated woodpeckers if abundant large snags persist (Bull et al. reviewed in Parks 2009).

Nest tree species frequently chosen by the pileated woodpecker in Oregon include ponderosa pine and Douglas fir. Pileateds have also been documented using large aspen for nesting (Carriger and Wells 1919, Grinnell and Miller1944, PRBO 2007). Over 70 percent of nest cavities in northeastern Oregon faced between a northeasterly and southwesterly direction (Bull and Jackson 1995).

Pileated woodpecker forages extensively on carpenter ants *(Camponotus spp.*), which are prevalent in decaying downed woody material in coniferous forests of the west (Bull and Jackson 1995). A study in Oregon found that 38 percent of foraging was on down logs and that they selected for logs with a diameter greater than 15 inches with extensive decay (Bull and Holthausen 1993, Torgersen and Bull 1995).

Prescribed fire may have negative short-term impact on pileated woodpecker because of the reduction in down wood and direct killing of carpenter ants (Bull et al. 2005). Mechanical treatments also significantly reduced snags and down wood but did not impact foraging by pileated woodpecker as much as areas that were mechanically treated and then burned. Fuel treatments should make stands more resilient to high intensity fire while maintaining large down wood, snags, and relatively high tree density (Bull et al. 2005).

Habitats with high densities of down logs and snags are preferred. Schroeder (1982) summarizes one Oregon study where pileated woodpeckers spent 36 percent of their feeding time foraging on logs, 35 percent on live trees, and 29 percent on snags. Typically, the male and female each digs and uses its own roosting cavity (Terres 1980), which may be separate from the cavity used by the pair for nesting. Over a 10-month period, individual birds may utilize an average of seven (range 4-11) different trees for roosting purposes (Bull and Jackson 1995). The number of snags needed to support maximum pileated woodpecker populations have been estimated by several researchers and include the following recommendations (Schroeder 1982): 18-26 inches dbh snags at a density of 0.24 snags/acre; snags greater than 20" dbh at a density of 0.14 snags per acre; and snags greater than 20 inches dbh at a density of 0.13 snags per acre. Shroeder's (1982) habitat model assumes that optimum or maximum pileated woodpecker habitat contain 30 or more trees greater than 20 inches dbh per acre; 10 or more logs greater than 7 inches diameter and/or stumps of the same diameter and greater than 1 foot high per acre; 0.17 or more snags per acre, where a snag is defined as greater than 20 inches dbh. PRBO (2007) found optimal habitat where the average DBH of all snags greater than 20 inches is 30 inches, and recommends retention of all snags in occupied pileated habitat (PRBO 2007).
In California, this species has been documented at elevations as low as 500 feet and as high as 7500 feet (Grinnell and Miller 1944). Most nests are within 164 feet of water and no farther than 492 feet from water (Schroeder 1982).

Pileated woodpeckers breed at age 1. Mean annual adult survival over an 8-year period in northeast Oregon was 64 percent with a 35.40 percent standard deviation (Bull and Jackson 1995). Pileated woodpeckers may live for up to nine years. To date, there are no estimates of the minimum viable population size for this species (Jackson et al.1998).

Ecological Role

Recent research indicates that pileated woodpeckers are a keystone species in western forests (Aubry and Raley 2002b). It is the only species capable of creating large cavities in trees and snags, and the only species which forages exclusively by excavating. These cavities produce habitat for dozens of species, including many of management concern due to their rarity and endangerment. Pacific fisher commonly uses cavities excavated or expanded by pileated woodpeckers for natal or pre-weaning dens (Aubry and Raley 2006, Higley and Matthews 2009).

In addition to primary excavation of large new cavities in live trees or snags for nesting, pileated woodpeckers also expand openings within trees that are hollowed out by advanced decay by heart-wood fungi. Their foraging and excavating activities provide dispersion of heartwood fungi (e.g., Aubry and Raley 2002b).

Pileated woodpeckers create a relatively large nest cavity for nesting in live trees or snags that have been softened by heartwood decay and, for roosting, excavate openings into portions of trees that have been hollowed out by advanced decay (Bull et al. 1992, McClelland and McClelland 1999, Aubry and Raley 2002a). Also, through both cavity and foraging excavations, woodpeckers may facilitate the inoculation of live trees with heart-rot fungi (e.g., Aubry and Raley 2002b).

Because of its role as a keystone species and its strong association with large snags and decadent live trees, the pileated woodpecker may be a particularly appropriate ecological indicator for effectiveness monitoring of species associated with late-successional forest conditions such as the Pacific fisher and California spotted owl as well as secondary cavity nesting species. Secondary cavity nesters are almost wholly dependent upon the pileated woodpecker because it is the only primary cavity excavator in the forests of the Sierra Nevada. Approximately 45 of cavity-nesting birds and 10 mammal species on the west slope of the Sierra Nevada utilize snags for nesting habitat (Raphael and White 1984).

Threats

Threats considered to be most important to this species include: conversion of forest habitats to non-forested habitats; short-rotation, even-age forestry management; monoculture forestry; forest fragmentation; and removal of logging residue and downed wood from the forest floor. In particular, the removal of logging residue and downed wood takes away the nutrients and foraging substrates for pileated woodpeckers and also reduces the overall water content of the forest floor, making it less suitable for the arthropod fauna that this species is dependent on (Jackson et al.1998). Rotting snags and decaying living trees that are crucial habitat for pileated woodpeckers are also most likely to be removed as hazards during timber harvest. Pileated woodpeckers did not utilize remnant 1.0 ha patches in regeneration harvest areas or clearcut areas, even after 25-30 years post-experimental treatment (Gyug and Bennett 1995 in Aubry and Raley 2002b).

Researchers in the Lassen-Plumas National Forests found basal area in occupied sites averaged 170.40 sq. ft. for pileated woodpecker, compared to 117.40 sq. ft. at unoccupied sites; and canopy closure at occupied sites averaged 49 percent compared to 37 percent at unoccupied sites.

Desired Conditions

- Pileated woodpeckers are stable or increasing in number.
- Pileated woodpeckers are of a sufficient number and distribution to provide an adequate supply of cavities for secondary cavity utilizing species.

Objectives

- Manage pileated woodpecker home ranges for long term, multi-generational occupation (Bull et al. 2007).

- Identify habitat areas to manage with the objective of increasing the numbers of pileated woodpeckers.

- Emphasize habitat management for the pileated woodpecker in riparian forested habitats along rivers and large streams; and on the western (more humid) slopes of mountains, where food and nest habitat attributes are most plentiful.

Conservation Measures

- Follow the recommendations for vegetation management in this conservation strategy, including limits to timber harvest, and provisions to retain understory vegetation, large wood and large snags.

- Within areas where modeling predicts high habitat suitability for pileated woodpeckers (>40 percent; see PRBO 2007) or that is otherwise considered suitable habitat for this species:

    - No even-aged timber management
    - Retain at least 150 sq.ft./acre basal area in treated stands
    - Manage to provide for home range habitat needs across areas ranging in size from 600-900 acres
    - Over half of the forested landscape should have canopy cover of 60 percent or greater
    - Limit timber harvest operations near known nesting sites or high concentrations of this species during the peak of the breeding season (April – June).

- As a general standard throughout forested areas:

    - Leave all snags over 18 inches DBH
    - Retain all large downed logs – pileated's forage on carpenter ants in downed wood. Retain as much downed wood over 15 inches diameter as is feasible while meeting fuel reduction objectives. Priority should be given to the largest diameter material in a range of decay classes.

- Conduct population monitoring, utilizing techniques such as banding and recapture studies, telemetry studies, and other censuses. PRBO (2007) recommends employing active playbacks and road based surveying utilizing vehicles to move quickly between distant survey points.

- Conduct habitat monitoring, both within and across regions. Utilize and refine the habitat model developed by PRBO (2007) to manage for well distributed populations.

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APPENDIX B
SUMMARY OF SPECIAL STATUS SPECIES

The following tables list the special status species found in the Sierra Nevada. The status for a number of species is currently under review by the US Fish and Wildlife Service, US Forest Service and California Department of Fish and Game. The tables below will be updated as new information is made available.

The definitions for status noted for each species in the tables below:

FE Federally Endangered Species
FT Federally Threatened Species
FC Federal Candidate for listing
FWBP Federal "Warranted but Precluded"
FSS Forest Service, Region 5, Sensitive Species
SAR Forest Service, Region 5, Species at Risk (L = low vulnerability; M = moderate vulnerability; H = high vulnerability)
MIS Forest Service, Region 5, Management Indicator Species
CE California Endangered Species
CT California Threatened Species
CC California Candidate for listing
CSSC California Species of Special Concern
CFP California Fully Protected
ACWL Audubon California Watch List Species
GS Natural Heritage Network conservation status ranking from NatureServe
WL California Department of Fish and Game Watch List Species
BCC U.S. Fish and Wildlife Service Bird of Conservation Concern
SC1 Threatened or Endangered or qualifies as such (Moyle et al. 2011)
SC2 Special Concern (Moyle et al. 2011)
SC3 Watch list (Moyle et al. 2011)
CRPR California Rare Plant Rank (Plants Rare, Threatened, or Endangered in California and Elsewhere)
1B.1: Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
1B.2: Fairly threatened in California (20-80% occurrences threatened / moderate degree and immediacy of threat)
1B.3: Not very threatened in California (<20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

Table B-1. Special status mammal species of the Sierra Nevada (USDA Forest Service 2001, USDA Forest Service 2007).

Scientific Name	Common Name	Status
Martes caurina	Pacific marten	FSS, CSSC, MIS
Martes pennanti	Pacific fisher	FSS, FWBP, CSSC
Vulpes vulpes necator	Sierra Nevada red fox	FSS, CT
Gulo gulo	Wolverine	FSS

Scientific Name	Common Name	Status
Ovis canadensis sierrae	Sierra Nevada bighorn sheep	FE
Taxidea taxus	American badger	CSSC
Ursus americanus	Black bear	SAR-M
Aplodontia rufa californica	Sierra Nevada mountain beaver	GS, CSSC
Brachylagus idahoensis	Pygmy rabbit	CSSC, SAR-H
Lepus americanus tahoensis	Sierra snowshoe hare	CSSC, SAR-H
Lepus townsendii	White-tailed jackrabbit	CSSC, SAR-H
Lepus californicus	Black-tailed jackrabbit	CSSC, SAR-H
Sorex lyelli	Mt. Lyell Shrew	GS
Lasirurs blossevillii	Western red bat	FSS
Antrozous pallidus	Pallid bat	FSS
Plecotus townsendii	Townsend's/Pacific Western big-eared bat	FSS
Myotis evotis	Long-eared Myotis	CSSC, SAR-M
Myotis volans	Long-legged Myotis	CSSC, SAR-M
Myotis thysanodes	Fringed Myotis	CSSC, SAR-M
Lasionycteris noctivagans	Silver-haired bat	CSSC, SAR-M
Lasiurus cinereus	Hoary bat	CSSC, SAR-M
Euderma maculatum	Spotted bat	CSSC, SAR-M
Eumops perotis	Western mastiff bat	CSSC, SAR-M
Ochotona princeps muiri	Yosemite pika	GS-T3 vulnerable
Ochotona princes albata	Mt. Whitney pika	GS-T3 vulnerable
Ochotona princeps schisticeps	Gray-headed pika	GS-T3 vulnerable
Glaucomys sabrinus	Northern flying squirrel	MIS
Neotoma fuscipes	Dusky-footed woodrat	MIS
Spermophilus lateralis	Golden-mantled ground squirrel	MIS

Table B-2. Special status bird species of the Sierra Nevada (USDA Forest Service 2001, USDA Forest Service 2007, California Department of Fish and Game 2011).

Scientific Name	Common Name	Status
Strix occidentalis occidentalis	California spotted owl	FSS, MIS
Strix nebulosa	Great gray owl	FSS, CE
Asio otus	Long-eared owl	CSSC
Accipiter gentilis	Northern goshawk	FSS
Accipiter cooperii	Cooper's hawk	WL
Accipiter striatus	Sharp-shinned hawk	WL
Otus flammeolus	Flammulated owl	ACWL, BCC
Dendragapus obscurus	Sooty grouse	MIS, SAR-M
Dendragapus fuliginosus howardi	Mt. Pinos sooty grouse	CSSC

Scientific Name	Common Name	Status
Centrocercus urophasianus	Greater sage grouse	FSS, MIS
Haliaeetus leucocephalus	Bald eagle	FSS
Gymnogyps californianus	California condor	FE, CE, CFP
Pandion haliaetus	Osprey	WL
Histrionicus histrionicus	Harlequin duck	CSSC
Patagioenas fasciata	Band-tailed pigeon	SAR-M
Cypseloides niger	Black swift	ACWL, SAR-M, CSSC
Chaetura vauxi	Vaux's swift	CSSC
Buteo swainsoni	Swainson's hawk	FSS
Grus canadensis	Greater sandhill crane	FSS
Picoides villosus	Hairy woodpecker	MIS
Melanerpes lewis	Lewis' woodpecker	BCC, ACWL
Picoides nuttallii	Nuttall's woodpecker	CSSC, ACWL
Picoides arcticus	Black-backed woodpecker	MIS
Picoides albolarvatus	White-headed woodpecker	CSSC, ACWL
Sphyrapicus ruber	Red-breasted sapsucker	CSSC
Sphyrapicus thyroideus	Williamson's sapsucker	CSSC, ACWL
Stellula calliope	Calliope hummingbird	ACWL
Certhia familiaris	Brown creeper	MIS
Chamaea fasciata	Wrentit	ACWL
Toxostoma redivivum	California thrasher	ACWL
Dendroica occidentalis	Hermit warbler	CSSC, ACWL
Dendroica petechia	Yellow warbler	MIS
Empidonax traillii	Willow flycatcher	CE
Contopus cooperi	Olive-sided flycatcher	SAR-M, CSSC, ACWL
Vireo gilvus	Warbling vireo	MIS
Vermivora ruficapilla	Nashville vireo	MIS
Poecile atricapillus	Black-capped chickadee	WL
Oreortyx pictus	Mountain quail	ACWL, SAR-L
Passerella iliaca	Fox sparrow	MIS
Spizella breweri	Brewer's sparrow	CSSC, ACWL
Amphispiza belli	Sage sparrow	CSSC, ACWL
Spizella atrogularis	Black-chinned sparrow	CSSC, ACWL
Carduelis lawrencei	Lawrence's goldfinch	ACWL

Table B-3. Special status reptile species of the Sierra Nevada (USDA Forest Service 2001, USDA Forest Service 2007).

Scientific Name	Common Name	Status
Xantusia vigilis sierrae	Sierra night lizard	FSS
Elgaria panamintina	Panamint alligator lizard	FSS, CSSC

Table B-4. Special status amphibian species of the Sierra Nevada (USDA Forest Service 2001, USDA Forest Service 2007, California Department of Fish and Game 2011).

Scientific Name	Common Name	Status
Rana sierrae and R. muscosa	Mountain yellow-legged frog complex	FWBP, FSS, CSSC
Rana draytonii	California red-legged frog	FT, CSSC
Bufo canorus	Yosemite toad	FC, FSS, CSSC
Batrachoseps simatus	Kern Canyon slender salamander	FSS, CT
Rana cascadae	Cascades frog	FSS, CSSC
Rana pipiens	Northern leopard frog	FSS, CSSC
Batrachoseps robustus	Kern Plateau salamander	FSS
Hydromantes brunus	Limestone salamander	FSS, CT, CFP
Batrachoseps stebbinsi	Tehachapi slender salamander	FSS
Batrachoseps campi	Inyo Mountains slender salamander	FSS, CSSC, BLMS
Batrachoseps relictus	Relictual slender salamander	FSS
Batrachoseps regius	Kings River slender salamander	FSS
Batrachoseps kawia	Sequoia slender salamander	FSS
Hydromantes shastae	Shasta salamander	CT, FSS
Hydromantes platycephalus	Mt. Lyell salamander	CSSC
Anaxyrus exsul	Black toad	CT, CFP
Batrachoseps spp.	Breckenridge Mt. slender salamander	CSSC, FSS
Ambystoma californiense	California tiger salamander	FT, CT, CSSC
Rana boylii	Foothill yellow-legged frog	CSSC, FSS, BLMS

Table B-5. Special status fish species in the Sierra Nevada (California Department of Fish and Game 2011, Moyle et al. 2011).

Species	Status	Moyle et al. 2011 Status	Modoc	Lassen	Plumas	Tahoe	Eldorado	Stanislaus	Inyo	Sierra	Sequoia
California golden trout *Oncorhychus mykiss aguabonita*	SC2	2-Vulnerable									x
Central California roach *Lavinia symmetricus symmetricus*	SC3	3-Watch List	x	x	x	x	x	x		x	x
Eagle Lake rainbow trout *Oncorhychus mykiss aquilarum*	SC2, FSS, CSSC, AFST	2-Vulnerable		x							
Eagle Lake tui chub *Siphatales bicolor subsp.*	SC3, FSS, CSSC, AFST	3-Watch List		x							
Goose Lake lamprey *Entosphenus sp.*	SC2, CSSC, ADSV	2-Vulnerable	x								
Goose Lake redband trout *Oncorhychus mykiss subsp.*	SC3, CSSC, FSS, AFSV	3-Watch List	x								

Species	Status	Moyle et al. 2011 Status	Modoc	Lassen	Plumas	Tahoe	Eldorado	Stanislaus	Inyo	Sierra	Sequoia
Goose Lake sucker *Catostomus occidentalis lacusanserinus*	SC2, CSSC, FSS, AFSV	2-Vulnerable	x								
Goose Lake tui chub *Siphatales thalassinus thalassinus*	SC3, CSSC, ADSV	3-Watch List	x								
Cowhead tui chub *Siphatales thalassinus vaccaceps*	SC2, CSSC, AFSE	2-Vulnerable	x								
Hardhead *Mylopharodon conocephalus*	SC3, CSSC, FSS	3-Watch List	x	x	x	x	x	x		x	x
Kern brook lamprey *Lampetra hubbsi*	SC2, CSSC, AFST	2-Vulnerable								x	x
Kern River rainbow trout *Oncorhychus mykiss gilberti*	SC1, FSS, CSSC, AFST	1-Endangered									x
Lahontan Lake tui chub *Siphateles bicolor pectinifer*	SC2, CSSC, FSS	2-Vulnerable				x					
Long Valley speckled dace *Rinichthys osculus subsp.*	SC1	1-Endangered							x		
McCloud River redband trout *Oncorhychus mykiss stonei*	SC1, CSSC, FSS, AFSV	1-Endangered	x	x							
Mountain sucker *Catostomus platyrhynchus*	SC3, CSSC	3-Watch List			x	x					
Mountain whitefish *Prosopium williamsoni*	SC3	3-Watch List				x					
Owens speckled dace *Rinichthys osculus. subsp.*	SC1, CSSC, AFST	1-Endangered							x		
Owens sucker *Catostomus fumeiventris*	SC3, CSSC	3-Watch List							x		
Pacific lamprey *Entosphenus tridentata*	SC3	3-Watch List	x								
Red Hills roach *Lavinia. symmetricus. subsp.*	SC2,	2-Vulnerable						x			
Sacramento hitch *Lavinia exilicauda. exilicauda*	SC3	3-Watch List						x		x	x

Table B-6. Special status plant species in the Sierra Nevada (California Native Plant Society 2012).

Scientific Name	Common Name	Status
Abronia alpina	Ramshaw Meadows abronia	FC, FSS, CRPR 1B.1
Allium abramsii	Abrams' onion	CRPR 1B.2

Scientific Name	Common Name	Status
Allium jepsonii	Jepson's onion	FSS, CRPR 1B.2
Allium tribracteatum	three-bracted onion	FSS, CRPR 1B.2
Allium yosemitense	Yosemite onion	CR, FSS, CRPR 1B.3
Arabis rigidissima var. demota	Galena Creek rockcress	FSS, CRPR 1B.2
Arctostaphylos nissenana	Nissenan manzanita	FSS, CRPR 1B.2
Astragalus anxius	Ash Valley milk-vetch	FSS, CRPR 1B.3
Astragalus cimae var. sufflatus	inflated Cima milk-vetch	FSS, CRPR 1B.3
Astragalus ertterae	Walker Pass milk-vetch	FSS, CRPR 1B.3
Astragalus johannis-howellii	Long Valley milk-vetch	CR, FSS, CRPR 1B.2
Astragalus lemmonii	Lemmon's milk-vetch	FSS, CRPR 1B.2
Astragalus lentiformis	lens-pod milk-vetch	FSS, CRPR 1B.2
Astragalus lentiginosus var. kernensis	Kern Plateau milk-vetch	FSS, CRPR 1B.2
Astragalus monoensis	Mono milk-vetch	CR, CRPR 1B.2
Astragalus oophorus var. lavinii	Lavin's milk-vetch	CRPR 1B.2
Astragalus pulsiferae var. pulsiferae	Pulsifer's milk-vetch	FSS, CRPR 1B.2
Astragalus pulsiferae var. suksdorfii	Suksdorf's milk-vetch	FSS, CRPR 1B.2
Astragalus ravenii	Raven's milk-vetch	FSS, CRPR 1B.3
Astragalus shevockii	Shevock's milk-vetch	FSS, CRPR 1B.3
Astragalus webberi	Webber's milk-vetch	FSS, CRPR 1B.2
Balsamorhiza macrolepis	big-scale balsamroot	CRPR 1B.2
Boechera bodiensis	Bodie Hills rockcress	CRPR 1B.3
Boechera constancei	Constance's rockcress	CRPR 1B.1
Boechera evadens	hidden rockcress	CRPR 1B.3
Boechera pinzliae	Pinzl's rockcress	CRPR 1B.3
Boechera shevockii	Shevock's rockcress	CRPR 1B.1
Boechera tiehmii	Tiehm's rockcress	CRPR 1B.3
Boechera tularensis	Tulare rockcress	CRPR 1B.3
Botrychium lineare	slender moonwort	FSS, CRPR 1B.3
Brodiaea insignis	Kaweah brodiaea	CE, FSS, CRPR 1B.2
Calochortus clavatus var. avius	Pleasant Valley mariposa-lily	FSS, CRPR 1B.2
Calochortus excavatus	Inyo County star-tulip	FSS, CRPR 1B.1
Calochortus longebarbatus var. longebarbatus	long-haired star-tulip	FSS, CRPR 1B.2
Calochortus palmeri var. palmeri	Palmer's mariposa-lily	FSS, CRPR 1B.2
Calochortus striatus	alkali mariposa-lily	FSS, CRPR 1B.2
Calochortus westonii	Shirley Meadows star-tulip	FSS, CRPR 1B.2
Calyptridium pulchellum	Mariposa pussypaws	FT, FSS, CRPR 1B.1

Scientific Name	Common Name	Status
Calyptridium pygmaeum	pygmy pussypaws	CRPR 1B.2
Camissonia integrifolia	Kern River evening-primrose	CRPR 1B.3
Camissonia sierrae ssp. alticola	Mono Hot Springs evening-primrose	FSS, CRPR 1B.2
Carex davyi	Davy's sedge	CRPR 1B.3
Carex tiogana	Tioga Pass sedge	FSS, CRPR 1B.3
Carex tompkinsii	Tompkins' sedge	CR, CRPR 4.3
Carlquistia muirii	Muir's tarplant	CRPR 1B.3
Carpenteria californica	tree-anemone	CT, FSS, CRPR 1B.2
Chlorogalum grandiflorum	Red Hills soaproot	CRPR 1B.2
Clarkia australis	Small's southern clarkia	FSS, CRPR 1B.2
Clarkia biloba ssp. australis	Mariposa clarkia	FSS, CRPR 1B.2
Clarkia biloba ssp. brandegeeae	Brandegee's clarkia	FSS, CRPR 1B.2
Clarkia gracilis ssp. albicaulis	white-stemmed clarkia	FSS, CRPR 1B.2
Clarkia lingulata	Merced clarkia	CE, FSS
Clarkia mildrediae ssp. mildrediae	Mildred's clarkia	FSS, CRPR 1B.3
Clarkia mosquinii	Mosquin's clarkia	FSS, CRPR 1B.1
Clarkia springvillensis	Springville clarkia	FT, CE, FSS, CRPR 1B.2
Collomia rawsoniana	Rawson's flaming trumpet	FSS, CRPR 1B.2
Cordylanthus eremicus ssp. kernensis	Kern Plateau bird's-beak	FSS, CRPR 1B.3
Cryptantha circumscissa var. rosulata	rosette cushion cryptantha	CRPR 1B.2
Cryptantha crinita	silky cryptantha	FSS, CRPR 1B.2
Cryptantha crymophila	subalpine cryptantha	CRPR 1B.3
Cryptantha incana	Tulare cryptantha	FSS, CRPR 1B.3
Cryptantha roosiorum	bristlecone cryptantha	CR, FSS, CRPR 1B.2
Cusickiella quadricostata	Bodie Hills cusickiella	CRPR 1B.2
Dedeckera eurekensis	July gold	CR, FSS
Deinandra mohavensis	Mojave tarplant	CE, FSS
Delphinium purpusii	rose-flowered larkspur	CRPR 1B.3
Draba asterophora var. asterophora	Tahoe draba	FSS, CRPR 1B.2
Draba asterophora var. macrocarpa	Cup Lake draba	FSS, CRPR 1B.1
Draba cruciata	Mineral King draba	CRPR 1B.3
Draba incrassata	Sweetwater Mountains draba	FSS, CRPR 1B.3
Draba monoensis	White Mountains draba	FSS, CRPR 1B.2
Draba sharsmithii	Mt. Whitney draba	FSS, CRPR 1B.3
Draba sierrae	Sierra draba	CRPR 1B.3
Eleocharis torticulmis	California twisted spikerush	FSS, CRPR 1B.3

Scientific Name	Common Name	Status
Eremogone cliftonii	Clifton's eremogone	CRPR 1B.3
Eriastrum tracyi	Tracy's eriastrum	FSS, CRPR 1B.2
Ericameria gilmanii	Gilman's goldenbush	FSS, CRPR 1B.3
Erigeron aequifolius	Hall's daisy	FSS, CRPR 1B.3
Erigeron inornatus var. keilii	Keil's daisy	FSS, CRPR 1B.3
Erigeron miser	starved daisy	FSS, CRPR 1B.3
Erigeron multiceps	Kern River daisy	FSS, CRPR 1B.2
Erigeron uncialis var. uncialis	limestone daisy	FSS, CRPR 1B.2
Eriogonum breedlovei var. breedlovei	Breedlove's buckwheat	FSS, CRPR 1B.2
Eriogonum luteolum var. saltuarium	Jack's wild buckwheat	CRPR 1B.2
Eriogonum mensicola	Pinyon Mesa buckwheat	CRPR 1B.3
Eriogonum microthecum var. panamintense	Panamint Mountains buckwheat	CRPR 1B.3
Eriogonum microthecum var. schoolcraftii	Schoolcraft's wild buckwheat	CRPR 1B.2
Eriogonum nudum var. regirivum	Kings River buckwheat	FSS, CRPR 1B.2
Eriogonum ovalifolium var. monarchense	Monarch buckwheat	CRPR 1B.3
Eriogonum prociduum	prostrate buckwheat	FSS, CRPR 1B.2
Eriogonum spectabile	Barron's buckwheat	FSS, CRPR 1B.2
Eriogonum twisselmannii	Twisselmann's buckwheat	CR, FSS, CRPR 1B.2
Eriogonum umbellatum var. ahartii	Ahart's buckwheat	FSS, CRPR 1B.2
Eriogonum umbellatum var. glaberrimum	Warner Mountains buckwheat	FSS, CRPR 1B.3
Eriogonum umbellatum var. torreyanum	Donner Pass buckwheat	FSS, CRPR 1B.2
Eriogonum wrightii var. olanchense	Olancha Peak buckwheat	FSS, CRPR 1B.3
Eriophyllum congdonii	Congdon's woolly sunflower	CR, FSS, CRPR 1B.2
Eriophyllum nubigenum	Yosemite woolly sunflower	FSS, CRPR 1B.3
Erythronium pluriflorum	Shuteye Peak fawn lily	FSS, CRPR 1B.3
Erythronium pusaterii	Kaweah fawn lily	FSS, CRPR 1B.3
Erythronium taylorii	Pilot Ridge fawn lily	FSS, CRPR 1B.2
Erythronium tuolumnense	Tuolumne fawn lily	FSS, CRPR 1B.2
Fissidens pauperculus	minute pocket moss	FSS, CRPR 1B.2
Frangula purshiana ssp. ultramafica	Caribou coffeeberry	CRPR 1B.2
Fritillaria brandegeei	Greenhorn fritillary	CRPR 1B.3
Galium angustifolium ssp. onycense	Onyx Peak bedstraw	CRPR 1B.3
Galium glabrescens ssp. modocense	Modoc bedstraw	FSS, CRPR 1B.2
Galium serpenticum ssp. warnerense	Warner Mountains bedstraw	FSS, CRPR 1B.2
Gilia yorkii	Monarch gilia	CRPR 1B.2
Githopsis tenella	delicate bluecup	CRPR 1B.3
Gratiola heterosepala	Boggs Lake hedge-hyssop	CE, CRPR 1B.2

Scientific Name	Common Name	Status
Hesperidanthus jaegeri	Jaeger's hesperidanthus	CRPR 1B.2
Hesperocyparis nevadensis	Piute cypress	CRPR 1B.2
Heterotheca monarchensis	Monarch golden-aster	FSS, CRPR 1B.3
Heterotheca shevockii	Shevock's golden-aster	FSS, CRPR 1B.3
Horkelia hispidula	White Mountains horkelia	FSS, CRPR 1B.3
Horkelia parryi	Parry's horkelia	FSS, CRPR 1B.2
Horkelia tularensis	Kern Plateau horkelia	FSS, CRPR 1B.3
Hosackia oblongifolia var. cuprea	copper-flowered bird's-foot trefoil	CRPR 1B.3
Hulsea brevifolia	short-leaved hulsea	FSS, CRPR 1B.2
Hulsea vestita ssp. pygmaea	pygmy hulsea	FSS, CRPR 1B.3
Iris hartwegii ssp. columbiana	Tuolumne iris	FSS, CRPR 1B.2
Iris munzii	Munz's iris	FSS, CRPR 1B.3
Ivesia aperta var. aperta	Sierra Valley ivesia	FSS, CRPR 1B.2
Ivesia aperta var. canina	Dog Valley ivesia	FSS, CRPR 1B.1
Ivesia campestris	field ivesia	FSS, CRPR 1B.2
Ivesia paniculata	Ash Creek ivesia	FSS, CRPR 1B.2
Ivesia sericoleuca	Plumas ivesia	FSS, CRPR 1B.2
Ivesia webberi	Webber's ivesia	FC, FSS, CRPR 1B.1
Juncus leiospermus var. leiospermus	Red Bluff dwarf rush	FSS, CRPR 1B.1
Juncus luciensis	Santa Lucia dwarf rush	CRPR 1B.2
Layia heterotricha	pale-yellow layia	FSS, CRPR 1B.1
Leptosiphon serrulatus	Madera leptosiphon	FSS, CRPR 1B.2
Lewisia cantelovii	Cantelow's lewisia	FSS, CRPR 1B.2
Lewisia congdonii	Congdon's lewisia	FSS, CRPR 1B.3
Lewisia disepala	Yosemite lewisia	FSS, CRPR 1B.2
Lewisia longipetala	long-petaled lewisia	FSS, CRPR 1B.3
Lewisia serrata	saw-toothed lewisia	FSS, CRPR 1B.1
Limnanthes floccosa ssp. bellingeriana	Bellinger's meadowfoam	FSS, CRPR 1B.2
Lomatium roseanum	adobe lomatium	FSS, CRPR 1B.2
Lomatium stebbinsii	Stebbins' lomatium	FSS, CRPR 1B.1
Lupinus citrinus var. citrinus	orange lupine	FSS, CRPR 1B.2
Lupinus duranii	Mono Lake lupine	FSS, CRPR 1B.2
Lupinus gracilentus	slender lupine	FSS, CRPR 1B.3
Lupinus latifolius var. barbatus	bearded lupine	FSS, CRPR 1B.2
Lupinus lepidus var. culbertsonii	Hockett Meadows lupine	FSS, CRPR 1B.3
Lupinus magnificus var. hesperius	Mcgee Meadows lupine	CRPR 1B.3
Lupinus padre-crowleyi	Father Crowley's lupine	CR, FSS, CRPR 1B.2

Scientific Name	Common Name	Status
Mentzelia inyoensis	Inyo blazing star	CRPR 1B.3
Mielichhoferia tehamensis	Lassen Peak copper moss	CRPR 1B.3
Mimulus evanescens	ephemeral monkeyflower	FSS, CRPR 1B.2
Mimulus filicaulis	slender-stemmed monkeyflower	FSS, CRPR 1B.2
Mimulus gracilipes	slender-stalked monkeyflower	FSS, CRPR 1B.2
Mimulus norrisii	Kaweah monkeyflower	CRPR 1B.3
Mimulus pictus	calico monkeyflower	CRPR 1B.2
Mimulus pulchellus	yellow-lip pansy monkeyflower	FSS, CRPR 1B.2
Monardella beneolens	sweet-smelling monardella	FSS, CRPR 1B.3
Monardella follettii	Follett's monardella	FSS, CRPR 1B.2
Monardella stebbinsii	Stebbins' monardella	FSS, CRPR 1B.2
Navarretia leucocephala ssp. bakeri	Baker's navarretia	CRPR 1B.1
Navarretia peninsularis	Baja navarretia	FSS, CRPR 1B.2
Nemacladus twisselmannii	Twisselmann's nemacladus	CR, FSS, CRPR 1B.2
Opuntia basilaris var. treleasei	Bakersfield cactus	FE, CE, CRPR 1B.1
Orcuttia tenuis	slender Orcutt grass	FT, CE, FSS, CRPR 1B.1
Oreonana purpurascens	purple mountain-parsley	FSS, CRPR 1B.2
Oreonana vestita	woolly mountain-parsley	FSS, CRPR 1B.3
Oreostemma elatum	tall alpine-aster	FSS, CRPR 1B.2
Orthotrichum shevockii	Shevock's bristle moss	CRPR 1B.3
Orthotrichum spjutii	Spjut's bristle moss	CRPR 1B.3
Packera eurycephala var. lewisrosei	Lewis Rose's ragwort	CRPR 1B.2
Packera layneae	Layne's ragwort	FT, CR, CRPR 1B.2
Penstemon personatus	closed-throated beardtongue	FSS, CRPR 1B.2
Penstemon sudans	Susanville beardtongue	FSS, CRPR 1B.3
Petrophytum caespitosum ssp. acuminatum	marble rockmat	CRPR 1B.3
Phacelia inundata	playa phacelia	FSS, CRPR 1B.3
Phacelia inyoensis	Inyo phacelia	FSS, CRPR 1B.2
Phacelia monoensis	Mono County phacelia	FSS, CRPR 1B.1
Phacelia nashiana	Charlotte's phacelia	CRPR 1B.2
Phacelia novenmillensis	Nine Mile Canyon phacelia	FSS, CRPR 1B.2
Phacelia stebbinsii	Stebbins' phacelia	FSS, CRPR 1B.2
Plagiobothrys parishii	Parish's popcorn-flower	CRPR 1B.1
Plagiobothrys torreyi var. torreyi	Yosemite popcorn-flower	CRPR 1B.2
Platanthera yosemitensis	Yosemite bog orchid	CRPR 1B.2
Poa sierrae	Sierra blue grass	CRPR 1B.3

Scientific Name	Common Name	Status
Polemonium chartaceum	Mason's sky pilot	FSS, CRPR 1B.3
Polyctenium williamsiae	Williams' combleaf	FSS, CRPR 1B.2
Polygonum polygaloides ssp. esotericum	Modoc County knotweed	FSS, CRPR 1B.1
Potentilla morefieldii	Morefield's cinquefoil	FSS, CRPR 1B.3
Pyrola chlorantha	green-flowered wintergreen	CRPR 1A
Pyrrocoma lucida	sticky pyrrocoma	FSS, CRPR 1B.2
Ribes menziesii var. ixoderme	aromatic canyon gooseberry	CRPR 1B.2
Rorippa columbiae	Columbia yellow cress	FSS, CRPR 1B.2
Rorippa subumbellata	Tahoe yellow cress	FC, CE, FSS, CRPR 1B.1
Rupertia hallii	Hall's rupertia	FSS, CRPR 1B.2
Schizymenium shevockii	Shevock's copper moss	CRPR 1B.2
Sedum albomarginatum	Feather River stonecrop	FSS, CRPR 1B.2
Senecio pattersonensis	Mount Patterson senecio	FSS, CRPR 1B.3
Sidalcea covillei	Owens Valley checkerbloom	CE, CRPR 1B.1
Silene occidentalis ssp. longistipitata	long-stiped campion	FSS, CRPR 1B.2
Streptanthus cordatus var. piutensis	Piute Mountains jewel-flower	FSS, CRPR 1B.2
Streptanthus fenestratus	Tehipite Valley jewel-flower	FSS, CRPR 1B.3
Streptanthus gracilis	alpine jewel-flower	FSS, CRPR 1B.3
Streptanthus oliganthus	Masonic Mountain jewel-flower	FSS, CRPR 1B.2
Symphyotrichum defoliatum	San Bernardino aster	FSS, CRPR 1B.2
Thelypodium howellii ssp. howellii	Howell's thelypodium	FSS, CRPR 1B.2
Trifolium bolanderi	Bolander's clover	FSS, CRPR 1B.2
Trifolium dedeckerae	Dedecker's clover	FSS, CRPR 1B.3
Tuctoria greenei	Greene's tuctoria	FE, CR, FSS, CRPR 1B.1
Viola pinetorum var. grisea	grey-leaved violet	CRPR 1B.3

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APPENDIX C
WILD AND SCENIC RIVERS:
STATUS OF EVALUATIONS AND COMPREHENSIVE RIVER MANAGEMENT PLANS

Eldorado National Forest

The planning record shows that a comprehensive eligibility evaluation was part of the 1988 Eldorado Forest Plan, although suitability studies and recommendations were not completed for several eligible streams. The Plan/ROD recommended a segment of the Rubicon River for designation, found eligible but did not recommend the North and Middle Forks of the Cosumnes River, and deferred the suitability determination of the eligible segments of the North Fork Mokelumne upstream of Salt Springs Reservoir to the Stanislaus Forest Plan (which subsequently recommended the upper segment). The North Fork Mokelumne below Salt Springs was studied in a separate EIS. This separate study/EIS was published in 1994, recommending 6.5 miles of the North Fork for designation, but not recommending another 10.5 miles further downstream due to a perceived conflict with the potential Devil's Nose dam project.

In response to appeals (see decision for appeals #89-13-00-0008 and 0016, dated 7/16/91), the Forest Service agreed to consider eligibility of additional rivers. In a letter dated 3/3/98, the Forest found 11 additional streams to be eligible. In addition, the appeals decision remanded the Forest Plan decision not to recommend segments of the North and Middle Forks of the Cosumnes River and the Forest was directed to reevaluate the suitability of the river segments in either a plan amendment or project level NEPA analysis. To date, no suitability analysis has been completed for the North and Middle Forks of the Cosumnes or the 11 other eligible streams identified in 1998.

In addition, changed circumstances requires revisiting the decision not to recommend the lower 10.5 miles of the North Fork Mokelumne River, since the FERC application for the Devil's Nose dam project was dropped by its proponents due to its poor economics. In addition, the BLM in 2007 recommended Wild & Scenic protection for 20.2 miles of the North Fork Mokelumne downstream of the Forest boundary due to its outstanding cultural, water quality, and scenic values. In contrast, the Forest Service using pre-1996 criteria, found its upstream segment to possess only outstanding cultural values. The demise of the Devil's Nose project, the adoption of 1996 eligibility criteria, and the eligibility findings and recommendation for the downstream BLM segment should prompt the Forest Service's reevaluation of the 10.5 mile segment of the North Fork not recommended in 1994.

The Eldorado Forest Plan Revision should carry through and include all existing recommended rivers (including the Rubicon River and North Fork Mokelumne), include complete suitability studies, and provide recommendations for all previously identified eligible streams.

Inyo National Forest

The 1988 Inyo Forest Plan/ROD did not assess any rivers or streams for Wild & Scenic, except for a portion of the South Fork Kern River identified in the Nationwide Rivers Inventory (NRI). In response to appeals, the Inyo Forest conducted an eligibility assessment that identified 15 eligible rivers and streams. A public notice was released on June 7, 1993 stating that the Inyo's "…proposed action is to recommend 15 streams or portions of stream for designation" and the notice solicited public input on the suitability of the streams. Unfortunately, no suitability study was actually completed or final recommendations provided. Some of the eligible streams, including Glass Creek, Deadman Creek, Big Springs, Owens River, and Cottonwood Creek (in the White Mountains), were subsequently designated by Congress in the Omnibus Public Lands Protection Act in March 2009.

The Inyo Forest Plan Revision should complete the suitability studies and provide recommendations for the remaining eligible streams. In addition, the plan should commit to completing as soon as possible comprehensive river management plans for the streams designated in 2009.

Lake Tahoe Basin Management Unit

No Wild & Scenic River studies were included in the 1988 Lake Tahoe Basin Plan. In response to concerns expressed by Friends of the River, Basin staff released eligibility determinations for upper and lower segments of the Truckee River in 1992. A suitability recommendation for the upper river segment and a non-suitable finding for the lower segment were documented in the 1999 Eight Eastside Rivers FEIS/ROD produced by the Tahoe Forest. No comprehensive evaluation of other streams in the Lake Tahoe Basin has been completed. In addition, changed circumstances require reconsideration of the lower Truckee River because the Humboldt-Toiyabe Forest found in 1998 the lower Truckee River to be eligible.

The Lake Tahoe Basin Revision should not only carry forward the existing recommendation for the main stem of the Upper Truckee River, it should consider including the Upper Truckee's tributaries, which share and contribute significantly to all of the Upper Truckee's outstandingly remarkable scenic, recreation, fish, and wildlife values. The plan revision should conduct a comprehensive evaluation of all streams, complete suitability recommendations for any additional streams determined eligible, and include a revaluation of the suitability of all segments the lower Truckee on the Lake Tahoe Basin, Tahoe Forest, and Humboldt-Toiyabe Forest.

Lassen National Forest

No comprehensive evaluation of potential Wild & Scenic Rivers was conducted in the 1992 Lassen Forest Plan. In response to public comments, nine streams were assessed, leading to eligibility determinations and recommendations for Antelope, Mill, and Deer Creeks. The six remaining streams were determined ineligible at that time but may now be eligible under 1996 eligibility criteria in the FSM. In addition, changed circumstances warrant consideration of additional stream segments since segments of four streams (Chips Creek, Indian Creek, Squirrel Creek, and Yellow Creek) determined eligible by the Plumas Forest in 1994 originate on the Lassen Forest. None of these streams were considered in the 1992 Lassen Plan.

The Lassen Forest Plan Revision should carry forward the existing recommendations for Deer, Mill, and Antelope Creeks and complete a comprehensive evaluation (including eligibility and suitability) of other potential Wild & Scenic Rivers. Where streams cross multiple jurisdictions (including the Plumas Forest and Lassen Volcanic National Park), a joint evaluation should be conducted by the appropriate agencies.

Modoc National Forest

A comprehensive evaluation of potential Wild & Scenic Rivers was conducted as part of the 1991 Modoc Forest Plan. Two streams – Willow and Boles Creeks – were determined eligible. Although the plan promised a suitability study for these eligible streams by 1994 (pg. 2, Modoc LRMP, 1991), no suitability study has been completed. Fifteen other streams primarily located in the Warner Mountains were determined ineligible in the comprehensive evaluation.

The Modoc Forest Plan Revision should reassess the streams determined ineligible in 1991 using the 1996 FSM eligibility criteria and new information concerning sensitive, threatened, and endangered species. In addition, the Modoc Forest Plan Revision should complete the suitability studies and make recommendations for Willow and Boles Creeks.

Plumas National Forest

The 1988 Record of Decision for the Plumas Forest Plan found a segment of the Fall River to be eligible and promised to initiate a suitability study as part of plan implementation. It is unknown whether this suitability study was ever conducted. As part of an appeal settlement agreement (Appeal #3044 of the 1988 Plumas Forest Plan, see settlement letter dated 2/4/91 from Forest Supervisor Mary Coulombe to Robert Dreher, Sierra Club Legal Defense Fund), the Plumas conducted a comprehensive eligibility evaluation of potential Wild & Scenic Rivers in 1994. Twenty-six stream segments were identified as eligible (including four stream segments that originate on the Lassen National Forest, and the Fall River segment), but no suitability study of the eligible segments has been completed. The Plumas Forest Plan Revision should complete the suitability study and recommendations for the 26 eligible river segments, including the Fall River.

Tahoe National Forest

In response to an appeal settlement agreement, the Tahoe Forest completed a comprehensive evaluation in 1991, finding 30 streams to be eligible. Suitability recommendations for five of the eligible streams, including the Upper Truckee River (actually located in the Lake Tahoe Basin Unit), Sagehen Creek, North Yuba River, Canyon Creek, and South Yuba River, were released in two separate documents – the Eight Eastside Rivers FEIS/ROD (February 1999) and the 22 Westside Rivers FEIS/ROD (May 1999).

Changed circumstances in the past decade, such as a significant increase in recreational use on the Downey River, Lavezzola Creek, and Pauley Creek, and recent acquisition of inholdings in Perazzo Canyon, the Little Truckee River, and on other eligible streams, should prompt a reassessment of some of the eligible streams for suitability. In addition, the Tahoe Forest Plan Revision should carry through and include the existing recommended rivers, including Canyon Creek, North Yuba River, South Yuba River, and Sagehen Creek.

Sequoia National Forest

The 1998 Sequoia Forest Plan did not include a comprehensive eligibility evaluation of all potential Wild & Scenic Rivers, but it did evaluate rivers identified in the Nationwide Rivers Inventory (NRI). The NRI rivers were subsequently designated by Congress, including portions of the North and South Forks of the Kern River, and the South Fork and main stem of the Kings River. A 13.2-mile segment of the lower Kern River was also determined eligible in the final 1988 Sequoia Forest Plan/ROD but no suitability study was completed or recommendation provided. In response to appeals of the plan, the Forest Service completed a separate study for a one mile segment of the South Fork Kern River and recommended it for designation in 1988. As part of the 1991 Kings River Special Management Area Plan, the agency found a 13-mile segment of the main stem of the

Kings River downstream of the designated segment (shared by the Sierra and Sequoia Forests) to be eligible, but did not complete a suitability study.
Also in the appeal settlements, the Forest Service agreed to conduct a limited screening of 11 rivers and streams in the Sequoia Forest and complete eligibility and suitability studies within an agreed upon timeframe. The Forest Service completed the assessment of the 11 streams in 1994 and determined four to be eligible. These eligible segments include the Little Kern River, additional segments of the lower Kern upstream and downstream of the segment already determined eligible, as well as the North Fork Tule River and North Fork Middle Fork Tule River. No suitability studies were completed or recommendations made for these eligible segments. In addition, the BLM reportedly will recommend its 3-mile segment of the lower Kern River for Wild & Scenic protection in final Bakersfield RMP (due out in late 2012).

The Sequoia Forest Plan Revision should complete suitability studies of the existing eligible streams and conduct a comprehensive evaluation (including eligibility and suitability) of other streams.

Sierra National Forest

The 1991 Sierra Forest Plan/ROD assessed NRI rivers but no comprehensive evaluation of other streams was conducted. Six segments of the Merced and San Joaquin Rivers were determined eligible and recommended, some of which (the Merced and SF Merced) were designated by Congress in 1987. A portion of the main stem of the Kings River (shared with the Sequoia Forest) was determined eligible in the 1991 Kings River Special Management Area Plan, but no suitability study was completed. The BLM has recommended a three-mile segment of the North Fork Kaweah River in the 2011 Bakersfield Resource Management Plan (RMP). Upstream segments of the North Fork are shared by the National Park Service (as part of the Sequoia-Kings Canyon National Park) and the Sierra Forest.

The Sierra Forest Plan Revision should complete the suitability study and recommendation for the main stem Kings River (in coordination with the Sequoia National Forest) and conduct a comprehensive evaluation to determine if any non-NRI rivers are eligible and suitable. High on the list of likely eligible/suitable rivers on the Sierra Forest is Dinkey Creek. The Forest Service should take special care in planning and analyzing impacts to current Wild and Scenic River eligibility in the recommended Dinkey Creek segments until it is officially designated in the Wild and Scenic River system. In addition, the plan should include a joint evaluation of all of the North Fork Kaweah River, including segments managed by the NPS, Sierra Forest, and BLM.

Stanislaus National Forest

The 1991 Stanislaus Forest Plan ROD included a comprehensive evaluation that identified 24 eligible river segments, of which eight river segments were recommended for designation. The Clavey River and its two tributaries, Bell and Lily Creeks, were determined eligible but initially not recommended because of an active FERC hydro license application on the river. Friends of the River and other groups appealed the non-suitability recommendation for the Clavey River. While the appeal was pending, FERC denied the Clavey hydro license application in 1994. Consequently, the Forest Service began a reassessment of the Clavey's suitability in 1995 and recommended the river and its tributaries for designation in 1996.

The 11 recommended river and stream segments, including the Clavey and its tributaries, should be carried through and included in the Stanislaus Forest Plan Revision.

Table C-1. Summary of evaluations and recommendations for action by national forest.

National Forest	Comprehensive Evaluation?	Eligible (# segments)	Suitable (# segments)	Proposed Plan Revision Action
Eldorado	Yes	14	2 completed 11 incomplete	Carry through existing recommendations. Complete suitability study for 11 eligible streams. Reconsider lower NF Mokelumne due to new info.
Inyo	No	15	Incomplete	Complete suitability study of eligible streams.
Lake Tahoe Basin	No	2	2	Conduct comprehensive evaluation.
Lassen	No	3	3	Carry through existing recommendations. Conduct comprehensive evaluation.
Modoc	Yes	2	Incomplete	Complete suitability for 2 eligible streams. Conduct comprehensive evaluation using 1996 criteria.
Plumas	Yes	26	Incomplete	Complete suitability studies.
Sequoia	No	13	5 completed 8 incomplete	Complete suitability for remaining 8 eligible streams.
Sierra	No	7	6 completed 1 incomplete	Complete suitability for 1 remaining eligible stream. Conduct comprehensive evaluation.
Stanislaus	Yes	24	11	Carry through existing recommendations.
Tahoe	Yes	30	5	Carry through existing recommendations. Reconsider some ineligible streams due to new information.

Status of Comprehensive River Management Plans on National Forests in the Sierra Nevada

For rivers designated by Congress after January 1, 1986, the National Wild & Scenic Rivers Act requires the federal management agency to prepare a comprehensive river management plan (CRMP) within three years of designation to provide for the protection of river values. The plan shall address resource protection, development of lands and facilities, user capacities, and other management practices necessary or desirable to achieve the purposes of the Act. The plan shall be coordinated with and may be incorporated into resource management planning for affected adjacent Federal lands and shall be prepared in consultation with State and local governments and the interested public. For rivers designated before January 1, 1986, all boundaries, classifications, and plans shall be reviewed for conformity with the Act within ten years through regular agency planning processes.

There are 578 miles of designated Wild & Scenic Rivers on the National Forests in the Sierra Nevada. Designation dates range from 1968 to 2009. Existing CRMP for designated rivers were prepared more than 18 years ago and the level of detail and sophistication of the CRMPs vary significantly. In the Forest Plan Revisions for the Sierra Nevada National Forests, the Forest Service should include a CRMP for rivers that lack

one and update all existing CRMPs. At the minimum, the Forest Plan Revisions should commit to provide a new CRMP or CRMP update as part of plan implementation.
Designated Wild & Scenic Rivers and CRMPs on the National Forests in the Sierra Nevada include:

Middle Fork Feather River (Plumas National Forest) – The Middle Fork Feather is one of the first eight rivers designated when Congress passed the National Wild & Scenic Rivers Act in 1968. There is an undated "River Plan" produced by the Plumas Forest that is 20 pages long, quite general in nature, and fails to meet CRMP standards as outlined by Congress. The plan was produced prior to 1976 because the maps in the plan include the braided Sierra Valley segment of the river, which was removed from the system by Congress in 1976. A major problem with the plan is that it fails to identify the specific outstandingly remarkable values of the river. At the minimum, the Plumas Forest Plan Revision should review this river plan for conformity with the Act and either include an updated CRMP in the Revision or commit to completing a CRMP during forest plan implementation, consultation with the Sate of California (which manages Middle Fork fisheries as a state-designated Wild Trout Stream).

North Fork American River (Tahoe National Forest, BLM) – Designated by Congress in 1978, there is a "Management and Development Plan" for the river produced by the Forest Service and BLM. The plan is quite short and general when compared to more sophisticated and detailed CRMPs produced today. The CRMP should be updated in the Tahoe Forest Plan Revision, in consultation with the BLM and with the State of California (since the North Fork is a state-designated Wild & Scenic River as well and its fisheries are managed by the State as a designated Wild Trout Stream). At the minimum, the plan revision should commit to completing a CRMP during forest plan implementation.

Tuolumne River (Stanislaus National Forest, BLM) – Designated by Congress in 1984, a management plan was produced for this river in 1987. The CRMP should be updated in the Stanislaus Forest Plan Revision in consultation with the BLM (which manages a short segment of the river) and the State of California (which manages Tuolumne fisheries as a state-designated Wild Trout Stream). At the minimum, the Plan Revision should commit to completing a CRMP during forest plan implementation.

Merced River (Sierra National Forest, BLM) – Designated by Congress in 1987, the Forest Service produced a CRMP for main stem and South Fork in 1991. The BLM also produced a draft CRMP for the lower Merced in 1990 but it is unclear whether this plan was ever finalized. The CRMP for the entire river on National Forest and BLM lands should be updated in the Sierra Forest Plan Revision in consultation with the BLM. At the minimum, the Plan Revision should commit to completing a CRMP during plan implementation.

Kings River (Sierra National Forest, NPS) – Designated by Congress in 1987, the Forest Service addressed Wild & Scenic River issues generally in a broader plan for the Kings River Special Management Area produced in 1991. The National Park Service (NPS) addressed classifications, boundaries, and outstanding values for the upstream segments of the Kings (including the Middle and South Forks) in the 2006 Sequoia-Kings Canyon General Management Plan. But no detailed CRMP has been produced for the Kings River. A CRMP for the entire river on National Forest and National Park lands should be included in the Sierra Forest Plan Revision in consultation with the NPS. At the minimum, the Plan Revision should commit to completing a CRMP during plan implementation.

Kern River (Sequoia and Inyo National Forests, NPS) – Designated by Congress in 1987, the Forest Service produced a CRMP for the North and South Forks of the Kern in 1994. The NPS addressed classifications, boundaries, and outstanding values for its upstream segment of the North Fork Kern in the 2006 Sequoia-Kings Canyon General Management Plan. The CRMP for the North and South Forks should be updated in the Sequoia Forest Plan revision in consultation with the NPS (in regard to the upper North Fork). At the minimum, the Plan Revision should commit to completing a CRMP during plan implementation.

Owens River Headwaters (Inyo National Forest) – The Owens River Headwaters, including segments of Glass Creek, Deadman Creek, Owens River, and Big Springs, was designated by Congress in 2009, which makes 2012 the three-year congressionally set deadline for a CRMP. The Forest Service should either initiate the CRMP process for this river or at the minimum, include the CRMP in the Inyo Forest Plan Revision.

Cottonwood Creek (Inyo National Forest) – Cottonwood Creek in the White Mountains was designated by Congress in 2009, which makes 2012 the three-year congressionally set deadline for a CRMP. The Forest Service should either initiate the CRMP process for this river or at the minimum, include the CRMP in the Inyo Forest Plan Revision.

STATUS OF SPECIAL INTEREST AREAS AND RESEARCH NATURAL AREAS

INTRODUCTION

This appendix provides and inventory of the existing research natural areas (RNAs) and Special Interest Areas (SIAs) on national forests in the Sierra Nevada and parts of the Southern Cascades. The appendix also includes management guidance from the Forest Service Manual and examples of management direction from the Tahoe National Forest Land and Resource Management Plan (LRMP) (Tahoe National Forest 1990).

CURRENT INVENTORY OF RNAS AND SIAS

The following table lists the RNAs current designated on national forests in the Sierra Nevada. Definitions for the column headings are noted below the table.

Table F-1. Current inventory of Research Natural Areas with attributes. The codes for Available Area, Special Unit Kind, and Status of RNA are defined in Table F 2. Taken from USDA Forest Service 2009.

Forest	Available Area	Special Unit Kind	Name of RNA	Status of RNA	Year Established	Area (acres)
Eldorado	2	230	Peavine Ridge	E	1991	1,098
Eldorado	3	230	Snow Canyon	E	2003	888
Eldorado	2	230	Station Creek	E	1991	746
					Forest Subtotal Area	2,731
Inyo	1	230	Harvey Monroe Hall	E	1933	3,863
Inyo	1	230	Indiana Summit	E	1932	1,161
Inyo	1	230	Last Chance Meadow	E	1983	653
Inyo	1	230	McAfee Meadow	E	2003	2,422
Inyo	1	230	Sentinel Meadow	E	1983	1,933
Inyo	1	230	Whippoorwill Flat	E	1990	3,256
Inyo	1	230	White Mountain	E	1953	2,029
					Forest Subtotal Area	15,316
Lake Tahoe Basin	1	230	Grass Lake	E	1991	355
					Forest Subtotal Area	355
Lassen	1	230	Blacks Mountain	E	1976	94

Forest	Available Area	Special Unit Kind	Name of RNA	Status of RNA	Year Established	Area (acres)
Lassen	1	230	Blacks Mountain	E	1976	99
Lassen	1	230	Blacks Mountain	E	1976	113
Lassen	1	230	Blacks Mountain	E	1976	73
Lassen	1	230	Blacks Mountain	E	1976	143
Lassen	1	230	Cub Creek	E	1981	3,953
Lassen	1	235	Grahams Pinery	P	0	639
Lassen	1	235	Green Island Lake	C	0	1,125
Lassen	1	235	Indian Creek	C	0	3,863
Lassen	1	235	Mayfield	C	0	1,075
Lassen	1	235	Soda Ridge	C	0	1,203
Lassen	1	235	Timbered Crater	C	0	1,784
					Forest Subtotal Area	14,163
Modoc	1	230	Devil's Garden	E	1933	796
Modoc	1	235	Raider Creek	C	0	6,274
					Forest Subtotal Area	7,070
Plumas	1	230	Mount Pleasant	E	1990	1,315
Plumas	1	230	Mud Lke Modoc Cypress	E	1989	299
Plumas	1	230	Mud Lke Modoc Cypress	E	1989	40
					Forest Subtotal Area	1,655
Sequioa	1	230	Church Dome	E	1991	1,509
Sequoia	1	230	Long Canyon	E	1990	2,132
Sequoia	1	230	Moses Mtn	E	1990	985
Sequoia	1	235	So. Mountaineer Creek	C	0	1,576
					Forest Subtotal Area	6,202
Sierra	1	230	Backbone Creek	E	1971	390
Sierra	1	235	Bishop Creek	P	0	1,113

Forest	Available Area	Special Unit Kind	Name of RNA	Status of RNA	Year Established	Area (acres)
Sierra	1	235	Home Camp Creek	P	0	949
Sierra	1	230	Sacate Ridge	E	2006	4,046
Sierra	1	230	San Joaquin Exp. Forest	E	1971	73
					Forest Subtotal Area	6,571
Stanislaus	3	230	Bell Meadow	E	1994	640
Stanislaus	1	235	Clark Fork	C	0	617
Stanislaus	3	230	Critchfield	E	1994	843
Stanislaus	3	230	Grizzly Mountain	E	1994	681
					Forest Subtotal Area	2,781
Tahoe	1	230	Babbitt Peak	E	1990	1,049
Tahoe	1	230	Lyon Peak/Needle Lake	E	1992	738
Tahoe	1	230	Sugar Pine Point	E	1992	647
					Forest Subtotal Area	2,434
Toiyabe Tahoe	1	230	Babbitt Peak	E	1990	364
					Forest Subtotal Area	364
					Forest Total	59,643

Table F-2. The following lists defines the codes used in Table F 1.

Column Label	Codes
Available area	1=Not Reserved
	2=Reserved - Current
	3=Reserved - Pending
Special Unit Kind	230=Research Natural Areas
	235=Proposed Research Natural Areas
Status of RNA	E=established
	C=candidate
	P=pending

Table F-3. List of RNAs with embedded website link to detailed information on each area. Summarized from: http://www.fs.fed.us/psw/programs/rna/

Map #	RNA Name and Website Link	National Forest	Target vegetation and other significant features
31	Grass Lake	Eldorado	moss bog, montane meadows
66	Peavine Point	Eldorado	Pacific ponderosa pine, California black oak
79	Snow Canyon	Eldorado	western white pine, subalpine meadows
85	Station Creek	Eldorado	transitional forest (sugar pine – white fir – rattlesnake orchid)
37	Harvey Monroe Hall	Inyo	alpine meadows, subalpine forest
45	Indiana Summit	Inyo	Jeffrey pine, archeology
51	Last Chance Meadow	Inyo	Sierran foxtail pine, meadow/stream
56	McAfee	Inyo	alpine fell-field
76	Sentinel Meadow	Inyo	lodgepole pine, limber pine
93	Whippoorwill Flat	Inyo	pinyon pine– juniper woodland, limber pine
94	White Mountain	Inyo	bristlecone pine, limber pine
11	Blacks Mountain	Lassen	interior ponderosa pine, sagebrush
22	Cub Creek	Lassen	mixed conifer forest
32	Green Island Lake	Lassen	moss bog, montane coniferous forest
43	Indian Creek	Lassen	blue oak – foothill pine
46	Iron Mountain	Lassen	Pacific ponderosa pine, California black oak
55	Mayfield	Lassen	knobcone pine, geology
80	Soda Ridge	Lassen	white fir, mixed conifer forest
89	Timbered Crater	Lassen	Baker cypress, vernal pool
24	Devil's Garden	Modoc	western juniper, *Artemisia* shrub-steppe
68	Raider Basin	Modoc	white fir, northern juniper woodland
60	Mount Pleasant	Plumas	red fir, bog fen
61	Mud Lake	Plumas	Baker cypress, biogeography
16	Church Dome	Sequoia	Jeffrey pine
52	Long Canyon	Sequoia	Piute cypress, California juniper, pinyon pine
58	Moses Mountain	Sequoia	giant sequoia, riparian/meadows
83	South Mountaineer Creek	Sequoia	red fir, montane wet meadows
6	Backbone Creek	Sierra	*Carpenteria californica*, unique ecosystem
9	Bishop Creek Ponderosa Pine	Sierra	Pacific ponderosa pine
41	Home Camp Creek	Sierra	white fir, red fir
74	San Joaquin Experimental Range	Sierra	blue oak – foothill pine
88	Teakettle Creek	Sierra	red fir
7	Bell Meadow	Stanislaus	aspen, montane meadows

Map #	RNA Name and Website Link	National Forest	Target vegetation and other significant features
17	Clark Fork	Stanislaus	white fir, red fir
33	Grizzly Mountain	Stanislaus	California black oak
40	Highland Lakes	Stanislaus	mountain hemlock forest
47	Jawbone Ridge	Stanislaus	chamise chaparral
96	William B. Critchfield	Stanislaus	red fir, montane meadows
53	Lyon Peak/Needle Lake	Tahoe	mountain hemlock, subalpine meadows
63	Onion Creek	Tahoe	white fir, red fir
87	Sugar Pine Point	Tahoe	mixed conifer forest, montane chaparral
5	Babbitt Peak	Tahoe/ Toiyabe	Washoe pine, mountain mahogany

Figure F-1. Locations of Research Natural Areas in California. Taken from USDA Forest Service 2009.

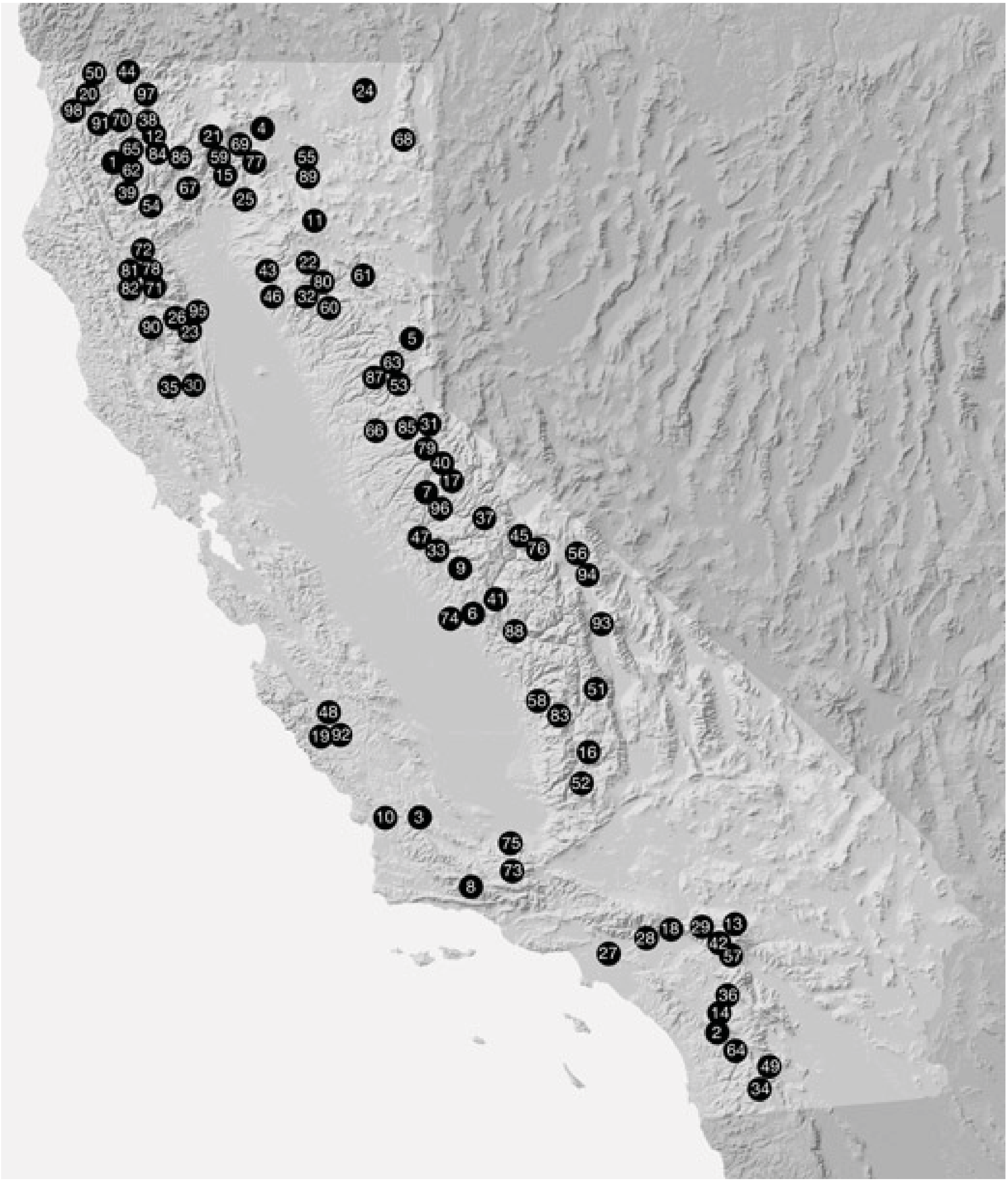

Table F-4. Current inventory of Special Interest. Taken from USDA Forest Service 2009.

Forest	Local Area Name	Special Interest	**acres**
Eldorado	Big Crater	Geological Areas	122.3
Eldorado	Leonardi Falls	Botanical Areas	214.9
Eldorado	Little Crater	Geological Areas	211.6
Eldorado	Mokelumne	Archaeologic Areas	335.1
Eldorado	Mokelumne	Archaeologic Areas	282.4
Eldorado	Mokelumne	Archaeologic Areas	9934.3
Eldorado	Mokelumne	Archaeologic Areas	320.8
Eldorado	Mokelumne	Archaeologic Areas	79.3
Eldorado	Mokelumne	Archaeologic Areas	56.2
Eldorado	Mokelumne	Archaeologic Areas	13.5
Eldorado	Mokelumne	Archaeologic Areas	18.8
Eldorado	Mokelumne	Archaeologic Areas	47.4
Eldorado	Mokelumne	Archaeologic Areas	1087.1
Eldorado	Rock Creek	Botanical Areas	211.8
Eldorado	Rock Creek	Botanical Areas	17.8
Eldorado	Rock Creek	Botanical Areas	137.6
Eldorado	Rock Creek	Botanical Areas	44.7
Eldorado	Round Top	Geological Areas	244.5
Eldorado	Round Top	Geological Areas	641.0
Eldorado	Traverse Creek	Botanical Areas	224.1
Eldorado	Wrights Lake Bog	Botanical Areas	65.3
		Forest Subtotal Area	**14310.5**
Inyo	Ancient Bristlecone Pine	Botanical Areas	28910.8
Inyo	Bighorn Sheep	Zoological Areas	19004.0
Inyo	Bighorn Sheep	Zoological Areas	21049.2
		Forest Subtotal Area	**69512.8**
Lake Tahoe	Tallac	Historic Areas	241.0
		Forest Subtotal Area	**241.0**
Lassen	Black Rock	Geological Areas	13.5
Lassen	Crater Lake	Geological Areas	192.2
Lassen	Deep Hole	Geological Areas	125.7
Lassen	Homer/Deer	Scenic Areas	1484.3
Lassen	Montgomery	Botanical Areas	5.2
Lassen	Murken Bench	Botanical Areas	480.6
Lassen	Willow Lake Bog	Botanical Areas	60.5
		Forest Subtotal Area	**2910.8**
Modoc	Burnt Lava Flow	Geological Areas	8217.2
Modoc	Glass Mtn Glass Flow	Geological Areas	74.5
Modoc	Glass Mtn Glass Flow	Geological Areas	4618.4
Modoc	Glass Mtn Glass Flow	Geological Areas	8.4

Forest	Local Area Name	Special Interest	acres
Modoc	Medicine Lake Glass Flow	Geological Areas	561.8
		Forest Subtotal Area	**14029.1**
Plumas	Butterfly Valley	Botanical Areas	501.5
Plumas	Feather Falls	Scenic Areas	14386.9
Plumas	Little Last Change Cyn	Scenic Areas	1541.2
Plumas	Soda Rock	Geological Areas	36.8
Plumas	Valley Creek	Botanical Areas	181.6
Sequoia	Baker Point	Botanical Areas	842.6
Sequoia	Bald Mount	Botanical Areas	437.9
Sequoia	Bodfish Piute Cypress	Botanical Areas	22.5
Sequoia	Bodfish Piute Cypress	Botanical Areas	280.7
Sequoia	Bodfish Piute Cypress	Botanical Areas	29.5
Sequoia	Bodfish Piute Cypress	Botanical Areas	15.0
Sequoia	Bodfish Piute Cypress	Botanical Areas	334.3
Sequoia	Freeman Grove	Botanical Areas (Prop)	3319.9
Sequoia	Freeman Grove	Botanical Areas (prop)	987.2
Sequoia	Packsaddle Cavern	Geological Areas	52.1
Sequoia	Slate Mountain	Botanical Areas	473.7
Sequoia	Twisselmann (Siretta Peak)	Botanical Areas	900.7
		Forest Subtotal Area	**8244.9**
Sierra	Carpenteria	Botanical Areas	386.3
Sierra	Courtright Intrusive Contact zone	Geological Areas	67.7
Sierra	Devils Peak	Botanical Areas	1342.0
Sierra	Dinkey Creek	Geological Areas	400.4
Sierra	King Caverns	Geological Areas	378.2
Sierra	McKinley Grove	Botanical Areas	410.3
Sierra	Nelder Grove	Historic Areas	1437.2
		Forest Subtotal Area	**4970.9**
Stanislaus	Bower Cave	Geological Areas	1746.0
Stanislaus	Bull Run	Geological Areas	369.5
Stanislaus	Columns of the Giants	Geological Areas	110.0
Stanislaus	Niagara Creek Falls	Geological Areas	585.0
Stanislaus	Pacific Madrone	Botanical Areas	7.4
Stanislaus	Pacific Madrone	Botanical Areas	7.4
Stanislaus	Trumbell Peak	Historic Areas	140.2
Stanislaus	Trumbell Peak	Historic Areas	3.9
Stanislaus	Windeler Cave	Geological Areas	11.2
		Forest Subtotal Area	**3529.4**
Tahoe	Devil's Postpile	Geological Areas	84.6
Tahoe	Glacier Meadows	Geological Areas	210.4
Tahoe	Grouse Falls	Scenic Areas	141.5
Tahoe	Mason Fen	Botanical Areas	16.3
Tahoe	Meadow Lake	Archaeologic Areas	9.8
Tahoe	Meadow Lake	Archaeologic Areas	63.3

Forest	Local Area Name	Special Interest	acres
Tahoe	Placer Co. Big Tree Grove	Botanical Areas	364.1
Tahoe	Sagehen Headwater	Botanical Areas	78.5
		Forest Subtotal Area	**968.5**
		Total Area	**132073.1**

ADDITIONAL INFORMATION TO CONSIDER IN DESIGNATING AND MANAGING RNAS AND SIAS

Management of Research Natural Areas

The Forest Service designates and manages a network of special areas on National Forests that are permanently protected and maintained in natural conditions, for the purposes of conserving biological diversity, conducting non-manipulative research and monitoring, and fostering education. Included in this network are:

- High quality examples of widespread ecosystems
- Unique ecosystems or ecological features
- Rare or sensitive species of plants and animals and their habitat

These RNAs help protect biological diversity at the genetic, species, ecosystem and landscape scales.

RNAs that are representative of common ecosystems in natural condition serve as baseline or reference areas. To help answer resource management questions, the baseline areas of RNAs can be compared with similar ecosystems undergoing silvicultural or other land management prescriptions. In this way, RNAs make an important contribution to ecosystem management.

RNAs are managed to maintain the natural features for which they were established, and to maintain natural processes. Because of the emphasis on natural conditions, they are excellent areas for studying ecosystems or their component parts and for monitoring succession and other long-term ecological change. Non-manipulative research and monitoring activities are encouraged in RNAs and can be compared with manipulative studies conducted in other areas.

RNAs serve as sites for low-impact educational activities. These areas are available for educational use by university and school groups, native plant societies, and other organizations interested in pursuing natural history and educational field trips.

The RNA system is envisioned to preserve a representative array of all significant natural ecosystems and their inherent processes as baseline areas. Although the RNA system has expanded significantly in recent decades, there are still many ecosystem types which are not represented. It has been especially challenging to secure RNA designations in the most productive forest and rangeland ecosystems where commodity uses have been concentrated. New areas which are proposed to fulfill gaps in the RNA system are evaluated through ongoing National Forest and National Grassland Land Management Planning efforts.

Responsibility for management of RNAs is shared between the National Forest System and Forest Service Research. The Regional Forester, with concurrence of the Research Station Director, has the authority to establish RNAs. In consultation with Forest Supervisors and District Rangers, the Station Director approves research and monitoring activities and management plans for RNAs. However, if the RNA is located within a Congressionally designated Wilderness or National Recreation Area, the Regional Forester approves these activities. The National Forest where the RNA is located has direct responsibility for day-to-day administration and management of the RNA. Management area direction for RNAs is contained within individual National Forest Land Resource Management Plans.

The overall goal of RNA management is to maintain the full suite of ecological processes associated with the natural communities and conditions for which the RNA was designed to protect. Until recently, the primary course of action was to leave RNAs alone. However, with the recent emphasis on ecosystem management in the Forest Service, more attention is being placed on restoration of natural processes such as fire, and control of invasive alien species which alter the composition and functioning of natural communities. Although it has been a goal to maintain natural processes such as fire in RNAs, the reality is that fire was suppressed in many of these natural areas as well as the rest of the landscape. Today, scientists and land managers are working on restoring the natural fire regime to RNAs as well as other portions of the landscape.

Direction on Research Natural Areas in the Forest Service Manual 4063

Research natural areas are part of a national network of ecological areas designated in perpetuity for research and education and/or to maintain biological diversity on National Forest System lands. Research natural areas are for non-manipulative research, observation, and study. They also may assist in implementing provisions of special acts, such as the Endangered Species Act and the monitoring provisions of the National Forest Management Act.

4063.01 - Authority. The general provisions of the Organic Administration Act of 1897 (16 USC 551) authorize the Secretary of Agriculture to designate research natural areas. Under regulations at 7 CFR 2.42, the Secretary has delegated this authority to the Chief, who, pursuant to 36 CFR 251.23, selects and establishes research natural areas as part of the continuing land and resource management planning process for National Forest System lands (36 CFR 219.25 and FSM 1922).

4063. 02 - Objectives. The objectives of establishing research natural areas are to:
1. Preserve a wide spectrum of pristine representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geological, and similar natural situations that have special or unique characteristics of scientific interest and importance that, in combination, form a national network of ecological areas for research, education, and maintenance of biological diversity.
2. Preserve and maintain genetic diversity.
3. Protect against serious environmental disruptions.
4. Serve as reference areas for the study of succession.
5. Provide onsite and extension educational activities.
6. Serve as baseline areas for measuring long-term ecological changes.
7. Serve as control areas for comparing results from manipulative research.
8. Monitor effects of resource management techniques and practices.

4063. 03 - Policy. Research Natural Areas may be used only for research, study, observation, monitoring, and those educational activities that maintain unmodified conditions. The selection and establishment of research natural areas within the National Forest System primarily emerges from continuing land and resource management planning and associated environmental analyses (FSM 1920 and FSM 1950). Forest plans shall include analysis of, and recommendations for, any proposed research natural areas establishment.

4063.41 (1) Vegetation Management. If such practices as prescribed burning and livestock grazing are to be used to maintain ecologic conditions, describe those practices, explain their use, and list their proposed scheduling. This shall include the prescription for fire in and near the research natural area, including the use of prescribed fire and the control of natural fire. If parts of the research natural area are assigned for eventual prescribed burning, they shall be described as well as areas assigned for permanent protection from fire. Control of fire within research natural areas shall be by methods that cause the least disturbance. Normally, methods that employ machinery shall not be used. In developing the prescription for fire, consider the role of natural fire in sustaining or managing the vegetation. If fire is prescribed, only part of the research natural area shall be allocated for prescribed burning and part shall be reserved for permanent protection.

Examples of Management Direction in RNAs from the Tahoe National Forest Land and Resource Management Plan (1990)

A16 Research Natural Areas (Tahoe National Forest 1990, p. V-54)**:**

Complete establishment reports and submit to Chief with recommendation for establishment for areas allocated as recommended Research Natural Areas.

Investigate and evaluate candidate areas for which final selection has not been made. If screening results in selection for Research Natural Area purposes, prepare Establishment Report and submit to Chief for establishment.

Established areas will be managed as Research Natural Areas. In the interim, areas will be managed to protect Research Natural Area Values until designation action is completed or the area has been dropped from further consideration. Unit is - areas

Occurs on those National Forest System lands allocated as candidate or recommended Research Natural Areas and on those areas subsequently established as Research Natural Areas.

P4 Fire Protection - Research Natural Areas (Tahoe National Forest 1990, p. V-193)

Control of fire within research natural areas shall be by methods that cause the least disturbance. Normally, methods that employ machinery shall not be used. In developing the prescription for fire, consider the role of natural fire in sustaining or managing the vegetation. If fire is prescribed, only part of the research natural area shall be allocated for prescribed burning and part shall be reserved for permanent protection. Exception to non-manipulative standard:

a) Suppression Strategy:

1) Contain: Fire intensity Level 1

2) Control: Fire Intensity Levels 2-6

The contain suppression strategy may be approved and extended to Fire intensity Level 2 if an analysis has shown that a fire at this intensity level does not threaten persons or property outside the area, or the uniqueness of the RNA.

b) Prevention

Because of low use of this area during periods of high intensity fire potential, prevention within the RNA will be limited; however, prevention of human-caused fires in higher-use areas outside the RNA will be aggressive to prevent fires that would threaten the RNA.

c) Fuel treatments

1. Inside RNA

Conduct all fuel treatment activities, including the use of planned prescribed fire, in accordance with the plan developed to manage and protect this area.

2. Outside (adjacent) to RNA

Where activity and natural fuels create a threat of a damaging fire carrying into the RNA, treat to a level that reduces the risk to an acceptable level.

Fire intensity levels (FILs) provide "an expression of fireline intensity, based on typical and/ or calculated flame length of a fire behavior condition. FILs are used in the analysis to reflect the differences in difficulty of suppression and fire effects on natural and cultural resources." (Ref. FSH5109.19 ch40.5 9/85) FPA uses the following FIL categories.

Table F-5. Fire Intensity Level (FIL) Categories

Fire Intensity Level	**Flame Length**	**Burning Index**
1	0-2	0-20
2	2.1-4	21-40
3	4.1-6	41-60
4	6.1-8	61-80
5	8.1-12	81-120
6	12 and over	121 and over

Management of Special Interest Areas

The following are examples of management direction for specific SIAs on the Tahoe National Forest.

Botany, aquatic and geologic (Tahoe National Forest 1990, p. III-29):

Candidate Research Natural Areas (RNA's) needed to complete the botanical target system will be identified. Preferred locations are in wilderness or Limited-use areas. The aquatic and geologic target system is deferred, and known unique areas will be considered and Special Interest Areas (SIAs) recommended on a case-by-case basis. Identified RNA's may be classified for research and educational purposes.

Cultural Resources (Tahoe National Forest 1990, pp. III-33 to III-34)

The TNF is charged with managing cultural resources as a nonrenewable resource to maintain their scientific, historical, and social integrity. A number of laws, Executive Orders, and regulations provide direction for the TNF cultural resource management program. These have been codified in FSM 2361 as objectives, policies, and responsibilities. Briefly, the TNF is charged with conducting an inventory of resources located within the Forest, evaluating recourses for their eligibility for the National Register of Historic Places, and managing those resources with historical, scientific, or social significance.

The TNF fosters and maintains relationships with the California Office of Historic Preservation, the President's Advisory Council on Historic Preservation, local universities and colleges, Native American tribes and organizations, historical societies, and parties interested in cultural resources of the TNF. The relationship with the California Office of Historic Preservation and the President's Advisory Council is formal and involves regular consultation as specified by 36 CFR 800. Cultural resource activities are also coordinated with the California State History Plan and the Statewide Archaeological Site Survey.

Consultation with Native American tribes and organizations occurs when Forest management decisions may affect cultural resources of interest or concern to Native Americans. These may be religious areas, archaeological sites or artifacts, or areas traditionally used by California Native Americans. The TNF is directed by the American Indian Religious Freedom Act to ensure that Its policies and procedures do not infringe upon Indian religious freedom.

Cultural resources are especially vulnerable to disturbance; once disturbed or damaged, the information lost is irreplaceable. Vandalism of cultural resources is a major concern. The large amount of private land within the TNF boundary and the ease of access to most areas of the Forest have contributed to an ever-increasing vandalism problem. Bottle and relic collectors have systematically disturbed historical sites Disturbance stems from use of metal detectors and shovels to obtain artifacts; in some cases heavy equipment is used. No specific activities are employed to remedy this situation. A comprehensive program of public education, site enhancement, 'antiquities' signing, and frequent patrolling will be necessary to reduce vandalism.

A major objective of the cultural resources program is identification and protection of cultural resources threatened by Forest projects. This is a base-level management strategy. Higher levels of management that may be initiated in the future include interpretive displays from specific cultural resources for public education and enjoyment, and intensified efforts to obtain scientific information through archaeological studies. The initiation of cultural resource inventories separate from Forest project impetus would increase the rate at which cultural resources are identified and protected. Separate cultural inventories would also help correct a bias in the cultural resource database from forested lands having received a disproportionate share of inventory work.

A15 Special Interest Area (Tahoe National Forest 1990, p. V-179)

Investigations and Management: Examine, establish, and manage specially designated areas that possess geological (including paleontology), botanical, scenic, zoological, cultural and other features that warrant protection through Special Interest Area classification according to 36 CFR 294 l(a). This includes National Natural Landmark designation. Unit is acres. Occurs on those NFS lands where a significant special interest feature has been identified.

Direction on Special Interest Areas in the Code of Federal Regulations (36 CFR 294.1):

“Suitable areas of national forest land, other than wilderness or wild areas, which should be managed principally for recreation use may be given special classification as follows: (a) Areas which should be managed principally for recreation use substantially in their natural condition and on which, in the discretion of the officer making the classification, certain other uses may or may not be permitted may be approved and classified by the Chief of the Forest Service or by such officers as he may designate if the particular area is less than 100,000 acres. Areas of 100,000 acres or more will be approved and classified by the Secretary of Agriculture”

References

Tahoe National Forest 1990. Land and resource management plan. USDA Forest Service, Region 5.

USDA Forest Service 2009. Research Natural Areas. Regional Level Datasets. Remote Sensing Lab, Region 5, USDA Forest Service. http://www.fs.usda.gov/detail/r5/landmanagement/gis/?cid=STELPRDB5327833