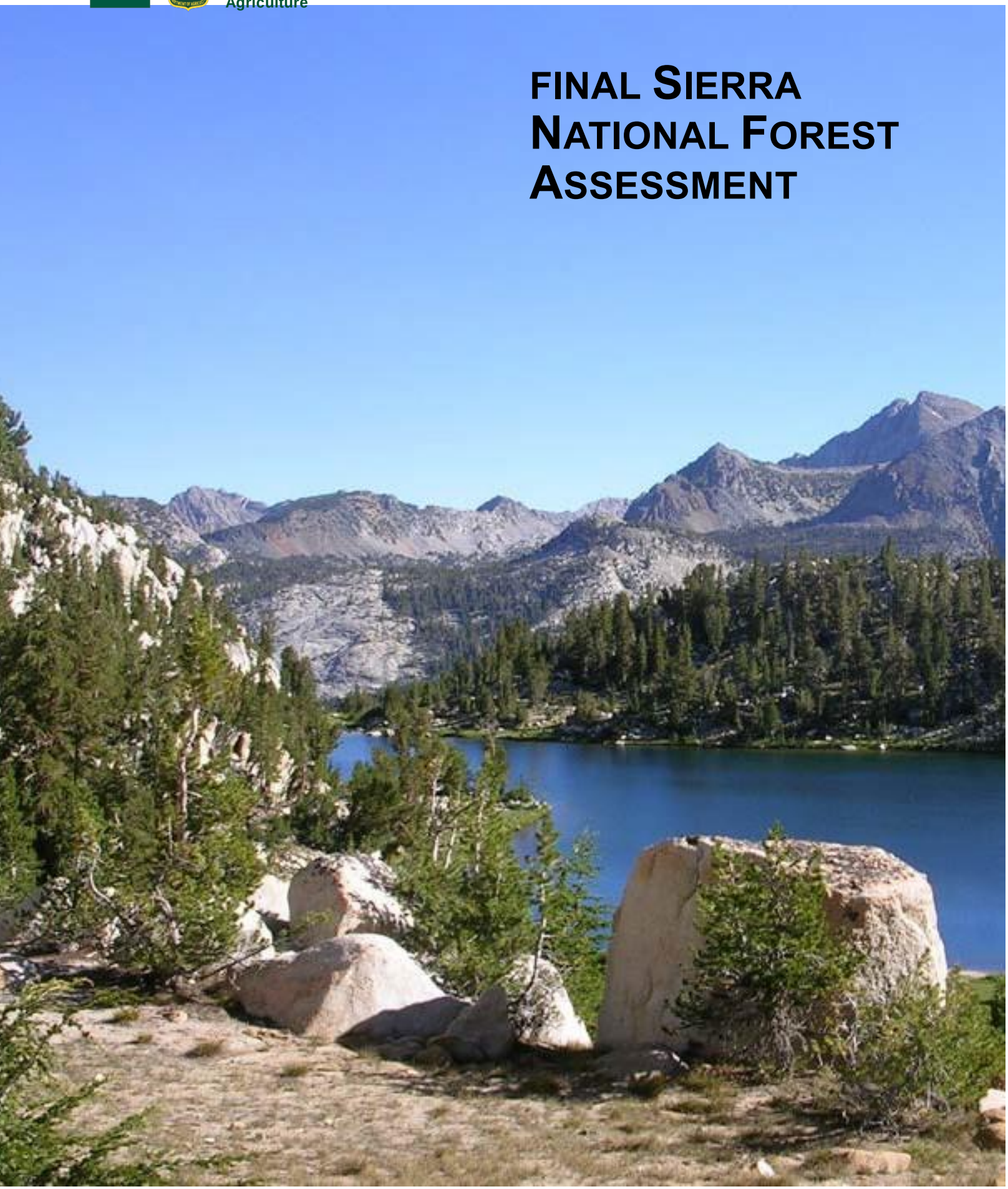
United States Department of Agriculture Forest Service

FINAL SIERRA NATIONAL FOREST ASSESSMENT



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INTRODUCTION

Purpose of the Assessment

The 2012 Planning Rule provides the process and structure to create local land and resource management plans for the national forests in California. The rule establishes an ongoing, three phase process: 1) assessment; 2) plan development or revision; and 3) monitoring. The 2012 Planning Rule is intended to create understanding around landscape scale management. It takes an integrated and holistic approach that recognizes the interdependence of ecological processes with social and economic systems. The approach uses best available science to inform decisions along the way. Collaboration with stakeholders and transparency of process are key ways the 2012 Planning Rule guides creation of forest plans for the future.

The Sierra NF Land and Resource Management Plan (LRMP) will consider a full range of multiple uses on National Forest System (NFS) lands where jobs are generated and economic opportunities are created.

This document represents the assessment stage and is designed to rapidly evaluate readily available existing information about relevant ecological, economic, and social conditions, trends, and sustainability and their relationship to the current land resource management plan within the context of the broader landscape. Assessments are not decision making documents, but provide current information on planning topics.

Structure of the Assessment

The Sierra National Forest is referred to throughout this document as "Sierra NF", or "the forest". The Sierra National Forest Land and Resource Management Plan is referred to as the "LRMP".

The Sierra NF Assessment begins with an INTRODUCTION to provide background about the process and to describe the assessment area. The next section is RESOURCES MANAGED AND EXISTING PLAN OBJECTIVES to help the reader with setting the context as the Sierra NF moves to forest plan revision under the 2012 Planning Rule. That is followed by an explanation of BEST AVAILABLE SCIENTIFIC INFORMATION. Next are FINDINGS for fifteen topics listed below. This section makes up the bulk of the assessment. CONCLUSIONS, REFERENCES, HELPFUL LINKS, and the Forest Service NON-DISCRIMINATION STATEMENT close out the assessment.

The Sierra NF Assessment identifies and evaluates existing information relevant to the plan area for the following topics laid out in the 2012 Planning Rule:

1. Ecological integrity: terrestrial ecosystems, aquatic ecosystems, and watersheds
2. Air, soil and water resources and quality
3. System drivers and stressors
4. Baseline assessment of carbon stocks
5. At-risk species
6. Social, cultural, and economic conditions
7. Benefits people obtain from the assessment area: ecosystem services
8. Multiple uses: Fish/Plants/Wildlife, Water, Timber and Range
9. Recreation settings, opportunities and access, and scenic character

10. Energy and minerals resources
11. Infrastructure
12. Areas of tribal importance
13. Cultural and historical resources and uses
14. Lands status and ownership, use, and access patterns
15. Designated areas, including wilderness and wild and scenic rivers, and potential for designated areas

The *Living Assessment*

Both the public and the 2012 Planning Rule envision wider and deeper levels of engagement in forest plan revision. There are a variety of ways the Sierra NF has interacted with the public in the early stages of the planning process. There has been engagement with the public at numerous face-to-face meetings and technology has been used to interact virtually. Since 2010, the Sierra Cascades Dialog, a group in made up of a broad spectrum of interested stakeholders, continues to be an important vehicle for engagement on forest planning. The on-line community called *Our Forest Place,* a non-Forest Service site, is where members interact on blogs and in discussion groups, and where they can find information about forest planning and current events. A wiki site, The *Living Assessment*, was set up to allow for information to be added to the 15 topics at both the bio-regional and forest scales.

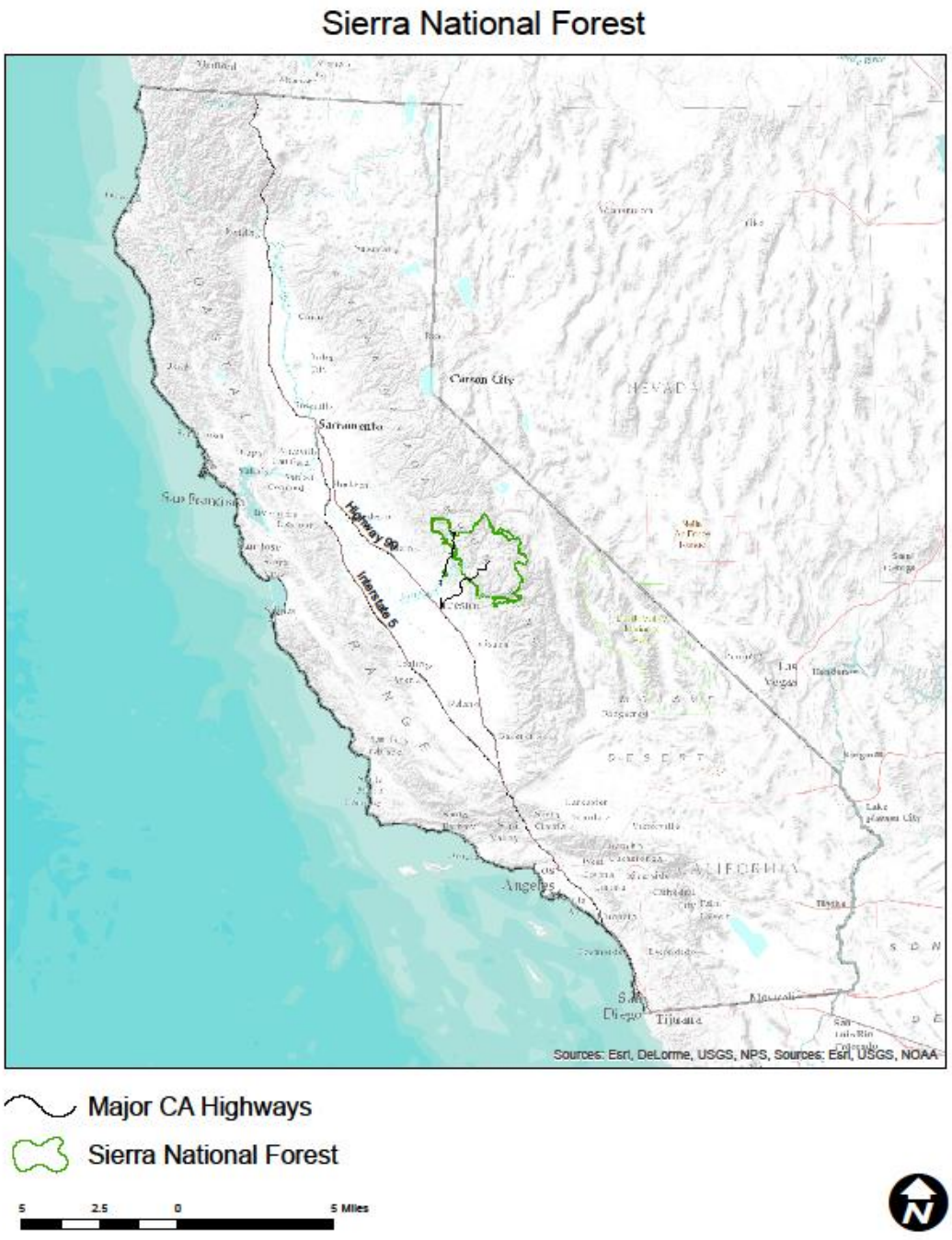
The information found in each of the chapters on the *Living Assessment* is intended to describe current conditions and trends. By outreaching to stakeholders, there has been direct engagement in contributing to the content, not just reviewing the information. Many interested stakeholders have added important and valuable input directly, creating a "living" body of work, in partnership with Forest Service scientists and specialists. This is an important shift in the approach to public involvement.

In January, 2013 the Regional Planning Team and Sierra NF staff began working with agency specialists, researchers, and interested stakeholders and providing their own initial contributions to the *Living Assessment*. Over the course of the next several months, the team monitored entries, gathered information, responded personally to questions and addressed concerns from contributors. They focused attention on topics where there was significantly more interest than others. All the information used in this assessment must be evaluated to ensure that it meets the standards of Best Available Scientific Information (BASI) as described in the 2012 Planning Rule. While the wiki environment has been extremely valuable in capturing and evaluating the information to determine when there are definitive sources and where there are uncertainties or conflicting information, it has also presented some challenges.

The FINDINGS section represents the rapid assessment of existing information about relevant ecological, economic, and social conditions, trends, and sustainability. The document is thoroughly cited and the complete REFERENCES section is found toward the end of the document. The reader is also provided information about where to find more detail in snapshots taken of the *Living Assessment*, including chapters and lines. These snapshots include an extended list of references.

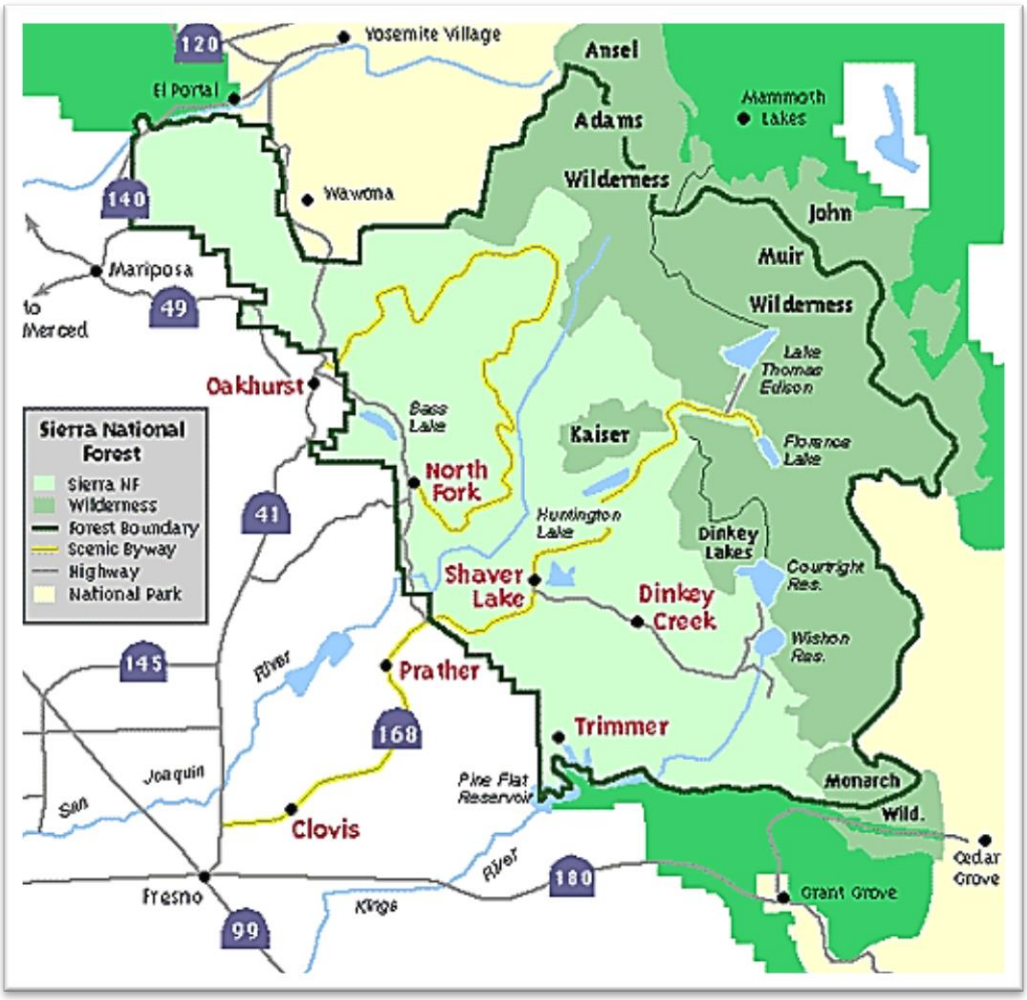
Maps of the Assessment Area

The first map below shows the Sierra NF and where it lies within the State of California. The second map describes the boundaries of the forest.



Map of the Sierra NF

The map below shows the Sierra NF boundary. The Sierra NF boundary starts clockwise at the intersections of the Merced River, The Sweetwater Creek and Highway 140, moves east following the Merced River canyon to the border with Yosemite National Park near El Portal. It follows the Yosemite's southern boundary until it reaches the Inyo National Forest near Electra Peak. From there it travels south to its border with the Kings Canyon National Park near Mt. Goethe. It then follows the Park's northern border. It heads south to the Kings River near Deer Canyon. From there it moves down the Kings River canyon east. South of the river is the Sequoia National Forest. When it reaches Pine Flat Lake near Trimmer, it turns north toward Tollhouse and continues on to Auberry. From there, it moves on to North Fork, then west to form a small finger toward Coarsegold. Finally, the boundary travels north to Yosemite Forks and moves west toward Miami Mountain, then heads north to return to the Merced River.



Map of the Sierra NF

Assessment Area, History and Distinctive Features

High elevation lakes, towering conifers, deeply carved river valleys and huge granite monoliths describe the Sierra NF. The Sierra NF is the gateway to the Sierras, including the intensely visited Yosemite, Sequoia, and Kings Canyon National Parks. The forest is divided into two ranger districts, Bass Lake and High Sierra, located in Mariposa, Merced and Fresno Counties. The forest is located along the west slope of the central-southern Sierra Nevada. The elevation changes from 900 feet at Pine Flat Reservoir, to nearly 14,000 feet at the summit of Mount Humphreys along the Sierra Crest.

On February 14, 1893, President Harrison proclaimed the Sierra Forest Reserve. Later as national forests were established, the Sierra NF became the second and largest national forest in California, nearly six times its current size. The forest was originally named for the Sierra Nevada Range which forms the backbone of California. In the intervening years, portions of the original Sierra NF were carved off to become parts of other adjacent national forests. The Sierra NF is the origin of the headwaters of the San Joaquin, Kings, and Merced Rivers and sustains the agricultural industry of the San Joaquin Valley.

The elevation range, combined with the variability in aspect and slope created by three deep river canyons, a variety of geology and soils, and precipitation primarily as rain at low elevations and snow at high elevations, create an extremely high diversity of ecosystems across the forest. The ponderosa pine is the predominant tree species on this forest and can be found between the 4,000 and 8,000 foot elevations. This area of the Sierra Nevada Range provides an important component for biological diversity in the landscape of the western United States. The Sierra NF is inhabited by over 1,400 plant species, and approximately 346 fish and wildlife species.

The forest's geomorphic foundation primarily consists of an uplifted, westward-tilted Sierra Nevada block that has been deeply incised by large rivers as well as their tributaries. Bedrock is primarily granite, along with limited metamorphic and volcanic presence, as well as glacial deposition in the lower river valleys. The terrain is dominated by steep slopes and rocky canyons, mixed with low slopes and flat areas.

Some areas of the forest contain unusual rock types like limestone, marble and gabbro. This creates soil chemistry that supports unique plant communities, and often harbors rare plant species. For example, there is a relatively large vein of limestone in the Kaiser Wilderness in Fresno County, where unique plant species such as the rare moonwort ferns (e.g. *Botrychium ascendens*, *B. crenulatum*) are found at meadow edges. The metamorphic rock type (phyllite) found in the Merced River drainage contains the entire world distribution for two plant species: Congdon's woolly sunflower (*Eriophyllum congdonii*) and the Merced clarkia (*Clarkia lingulata*).

Climate generally consists of warm, dry summers and cool, moist winters at the lower elevations, with harsher winters as elevation increases. Mean annual precipitation is 20 to 60 inches, with most falling as snow above 5,000 feet.

The Sierra NF provides a diversity of recreation opportunities to local rural residents, nearby communities and towns, and to the highly urban areas along the California coastline. Facilities

offer opportunities that range from highly developed campgrounds and picnic areas, to minimally developed overnight and day use areas that serve primarily as access points to trails, creeks, rivers and general forest areas.

The Sierra NF encompasses 1.3 million acres of land and water, with about 44 percent, or 577,140 acres, designated as wilderness. These areas offer solitude and vast open space as part of one of the largest contiguous blocks of wilderness in the continental United States.

The forest provides tremendous opportunities for hiking, horseback riding, and mountain biking, as well as off road vehicle use on trails jointly maintained by the Forest Service and many partners. The forest is home to two groves of giant sequoias, Nelder and McKinley Groves. Nelder Grove includes 1,006 mature giant sequoias and features the Shadow of the Giants Trail that provides interpretation to hikers on the ecology of the sequoias.

The Sierra NF provides opportunities for nature-based education to a wide variety of local and area residents. Programs like the Central California Consortium provide opportunities to students from communities in and around the San Joaquin Valley to learn about natural resources, as well as to contribute to their stewardship.

The Sierra NF has many historically significant sites. For instance, the Dinkey Creek Historic Bridge, which may be the only bowstring arch truss bridge in California, is located here. The bridge was built in 1938 and is listed on the National Register of Historic Places. The forest lies in the traditional territories of five federally recognized tribes, as well as a number of other tribes, groups, and tribal organizations. Tribal communities are important partners in forest management activities.

The Sierra NF has been largely affected by fire suppression for almost a century. As a result, live and dead fuels have increased to abnormally high levels of abundance, greater than the natural range of variability. The number of people using and living in and near the forest has grown, making fire management challenging. There are competing interests to: 1) provide protection for human life and property from wildfire; 2) reduce the undesired impacts from wildfire to forest resources; and 3) acknowledge that fire is an essential component of healthy ecosystems. Most wildfires continue to be suppressed at small sizes, however, fires that escape early suppression often burn severely for a few days and can add larger areas of moderate and high severity fire than are desired.

Historical logging, livestock grazing, hydroelectric power generation and residential development have also influenced ecological conditions and management across the landscape. For example, prior to the mid-1900s, and to a lesser extent from the mid-1900s to the early-1990s, logging on the Sierra NF, primarily within the lower and mid-slope areas (3,000 to 7,000 feet), typically consisted of removing many of the largest overstory trees. This was particularly significant on what is now the Bass Lake Ranger District, and came as a result of extensive railroad logging between the late 1880s and the 1930s. These actions resulted in substantial reductions of sugar, ponderosa and Jeffery pine forests.

The Sierra NF is within an hour's drive of several growing population centers in the San Joaquin Valley. The San Joaquin Valley has a highly diverse population that has increased over 10 percent in the last ten years and is projected to increase by 25–100 percent by 2050.

RESOURCES MANAGED AND EXISTING PLAN OBJECTIVES

Placed under federal protection and management in 1893, the Sierra NF has met the public's needs for more than a century. With its numerous lakes, abundant natural resources, contiguous wilderness and endless recreation opportunities, the Sierra NF is one of the most popular national forests in the United States. The mission statement of the Sierra NF (2006) is:

> *We manage the Sierra NF to maintain and restore healthy watersheds and diverse fire adapted plant and animal communities. We manage our public lands to provide outstanding experience unprecedented landscapes continuous wilderness and spectacular mountain lakes. We administer our programs and infrastructures to provide a safe workplace for our employees. We foster partnership and collaboration with stakeholders for the betterment of the forest and protection of our communities. We are committed to an adaptive approach to management that will leave the land in better conditions than it is today. As a result of our actions, we will generate forest products and healthy watersheds for future generations.*

Resource Management on the Sierra NF

The Forest Service manages NFS lands to sustain the multiple-use of its renewable resources in perpetuity, while maintaining the long term health and productivity of the land. Resources are managed through a combination of approaches and concepts for the benefit of human communities and natural resources. Land and resource management plans (LRMPs) guide sustainable, integrated resource management of the resources within the plan area in the context of the broader landscape, giving due consideration to the relative values of the various resources in particular areas (36 CFR Part 219.1(b)).

The Sierra NF LRMP was completed in 1992 and then amended in large part to incorporate the guidance in the 2004 Sierra Nevada Forest Amendment, commonly referred to as the 2004 Framework. The 1992 Sierra LRMP direction is provided through goals and objectives, followed by future conditions, then general management prescriptions and standards and guidelines. Finally, each management area has prescriptions, practices, outputs and activities. The 1992 LRMP lists 32 goals and objectives, which represent a wide variety of multiple uses including recreation, wilderness, wildlife, fish, livestock grazing, timber harvest, minerals, soils, water, air quality, cultural resources, transportation system, and fire management.

Management direction for the 2004 Framework is provided in the Record of Decision. The emphasis of the 2004 Framework is to adopt an integrated strategy for vegetation management that is aggressive enough to reduce the risk of wildfire to communities in the wildland urban interface, while modifying fire behavior over the broader landscape. Direction is provided for management goals and strategies, desired conditions, management intents and objectives, and management standards and guidelines. The 2004 Framework addressed five problem areas: old forest ecosystems and associated species; aquatic, riparian and meadow ecosystems and associated species; fire and fuels management; noxious weeds; and lower westside hardwood ecosystems.

The Sierra LRMP was again amended by the Sierra Nevada Forests Management Indicator Species Record of Decision in 2007. This decision amended the plans for the national forests in the Sierra Nevada to adopt a common list of management indicator species (MIS).

Budgets

The Sierra NF receives its funding from three sources: Appropriations, Revenue and Reimbursements. All national forests receive the majority of their funding from congressional appropriations.

Revenue is the funding earned through commercial ventures such as mining, timber sales, recreational activities and donations. The Sierra NF is not authorized to collect revenue from the majority of its commercial activities. Instead, it receives a portion of the collections via trust funds which are created from the proceeds of these activities. Similarly, the Sierra NF does not collect revenue directly from any of the concessionaire-owned facilities in the forest. All of the concessionaries operate under special use permits, which allow the forest to receive compensation. The 2005 Federal Land Recreation Enhancement Act increased the ability of national forests to recover their expenditures by charging fees at designated locations and includes special uses as well.

In terms of reimbursement, the forest receives funding for work performed by Sierra NF personnel on behalf of other agencies, for example, the Bureau of Land Management and other Forest Service units. The work performed is typically road and trail maintenance.

History

Between 1996 and 2005, the overall budget of the Sierra NF grew by approximately 7 percent, from $19.6 million in 1996 to $21 million in 2005. When adjusted for inflation, actual spending power of the forest decreased by 13 percent. Funding for fire pre-suppression and hazardous fuels reduction programs has increased over the past 10 years. Appropriations for these two programs in 2005 were 180 percent higher than in 1996. At the same time, appropriated funding for non-fire related activities declined slightly from $8.1 million in 1996 to $7.8 million in 2005. Revenue and reimbursement accounts also went down. With the reduction in the timber program, revenue declined 75 percent. Reimbursements hovered around $1.14 million amounting to a 19 percent adjusted decrease in these accounts with inflation.

Strategies

A financial analysis revealed a decline in appropriated funding and in turn, an increased dependency on other revenue. Therefore, many forest strategies focus on cost reduction and revenue generation. One important strategy is to increase the number and effectiveness of partners and volunteers. Other strategies focus on the mission: protecting and sustaining the forest ecosystem, and maximizing recreation opportunities by reaching out to surrounding communities.

Revenue Opportunities

Since 1908, every national forest has ceded to the U.S. Treasury gross receipts generated by the sale or commercial use of commodities on that forest. Twenty-five percent of these receipts were then sent back to the states in order to fund county schools and roads. Most of the capital behind the 25 percent fund came from timber sales. In the late 1980s, timber sale receipts began declining, and counties, especially those with a high percentage of National Forest System land, lost a significant source of funding.

In October of 2000, Congress passed the Secure Rural Schools and Community Self Determination Act to address declining federal receipts on local governments. Title II of the Act gave counties access to funds for reinvestment in forest and watershed health. The Recreational Fee Demonstration Program created by the Omnibus Consolidation Rescissions and Appropriations Act of 1996 is another funding source. Under this legislation, the Forest Service is able to charge user fees to its recreating visitors. The Sierra NF was able to obtain 20 percent of the revenue from its Golden Eagle Passports and wilderness reservations. The Sierra NF is also able to charge modest fees at campgrounds, rental cabins, high impact recreation areas and day use areas.

Trends

Although annual funding for the Sierra NF has hovered around $20 million since FY 1996, the distribution of the funding has changed dramatically. The most notable change in distribution comes from revenue, which has declined by 75 percent, since 1996. This decline is primarily due to the substantial reduction in timber harvesting that occurred in the Forest in the 1990s.

Another notable trend is the shift in appropriated funding from core forest operation to fire management. As the proliferation of wildfires became a nationwide concern at the turn of the last century, a series of executive directives were enacted to ensure that fire prevention and suppression measures received ample support. The funding for non-fire activities began to decline. At the same time, potential revenue-generating activities of the Sierra NF decreased. Between FY 2000 and FY 2001, revenue decreased 49 percent while appropriated fire funding increased 71 percent.

Apart from the funding supplied to the forest during emergencies, fire-related funding comes from two sources: hazardous fuels reduction and fire pre-suppression and preparedness dollars. Funding for hazardous fuel reduction pays for reducing hazardous under brush and vegetation in order to reduce the spread of active forest fires. Fire pre-suppression and preparedness funds pay for training, supplies, equipment, and public awareness campaigns. Between FY 1996 and FY 2005, fire-related appropriations to the Sierra NF increased from $3.7 million to $10.5 million. This 180 percent increase in fire-related appropriations is critical for preventing damaging wildfires, but leaves less to support other forest operations.

The facilities operations and maintenance programs have had the biggest shortfall. As federal appropriations decline, maintenance of the forest's physical infrastructure falls behind. Other program areas that experienced significant funding shortfalls were timber, law enforcement, and

planning. Although not as big in terms of dollar amounts, the trails and specially designated areas management programs are also experiencing funding declines.

The Human Factor and the Sierra NF

The list of forest accomplishments grows every year as a result of the dedication and perseverance of the Sierra NF team. This team is made up of dedicated employees, committed volunteers and interested and engaged partners. The Sierra NF continues to work side-by-side with other federal agencies, state and local governments, communities and individuals, tribes, nonprofits, corporations, and other organizations to build a collaborative relationship to meet the mission of the agency. The Forest Service strives to strengthen ways it can be a constructive community member and contribute to the well-being of the community, over and above financial support. True partnerships involve engaging in long term relationship-building, joint planning, goal-setting and implementation, accountability and "win-win" outcomes. Relationships with the tribes have always been important to the Sierra NF and continue to be critical as forest planning continues for the future. Coordination with tribal communities benefits both the landscape and the people who care deeply about it. Cooperating with and planning for the future alongside other governmental agencies, at the local, state and federal levels is extremely important in order to gain efficiencies and provide the best possible services to the public.

Risk Factors

The International Organization for Standardization defines risk as the “effect of uncertainty on objectives”. In this definition, uncertainties include events which may or may not happen, and those caused by ambiguity or a lack of information. The definition also includes both positive and negative impacts on objectives. The Bio-Regional Assessment addressed a number of uncertainties, or risk factors, such as climate change, population growth, demographic and value shifts, commodity market prices, regional economic conditions, political influence, and federal and state budgets.

In the short term these risk factors can impact the strength, frequency and intensity of fire, floods, weather events, insect and drought-related tree death, and even major court precedence. In the longer term, the strength, frequency and intensity of land use change, local economic trends, use patterns, and ongoing project litigation can be impacted.

The risks to the Sierra NF include a number of uncertainties, such as climate change, population growth, demographic and value shifts, commodity market prices, regional economic conditions, political influence, and federal and state budgets. Other risk factors to consider are communication, expected program budgets, skill and expertise deficiencies, time impacts, lack of information, and cooperation of others.

Risk factors are discussed in the body of the assessment in the terms of changes over time, trends, and information gaps.

BEST AVAILABLE SCIENTIFIC INFORMATION

This section explains 1) how the best available scientific information (BASI) was used in developing the assessment, and 2) how key scientific information was determined to be BASI, based on what is most relevant, accurate, and reliable.

In developing the chapter papers for the *Living Assessment*, Forest Service experts provided information supported by publications, scientific assessments, federal agency inventory and monitoring data, and other sources of scientific information such as expert opinion where available and which addressed the 15 topics.

The initial information on trend and conditions was then drafted and made available to the public on *The Living Assessment* and the Sierra NF website. Stakeholders provided feedback on the content of the topic papers, as well as additions of references and information directly, or submitted feedback on the content through email or hard copy letters. Stakeholders were asked to provide alternate or conflicting data sources and information, to not directly replace other valid information, and to provide references to support their additions to help the Forest Service evaluate conflicting views on conditions and trends. There were varying levels of response to that request.

A snapshot of the Sierra NF chapters on the *Living Assessment* was captured on July 2, 2013 so that a fixed set of information could be evaluated since the *Living Assessment* pages remain open to editing. The Forest Service followed the direction and guidance in the 2012 Planning Rule draft directives on the information to be collected to describe condition and trend, to make sure appropriate readily available information was considered in this forest assessment.

The Forest Service focused on the references to the Sierra chapter papers, the Science Synthesis, the Bio-Regional Assessment, and other information sources to identify information to be included in this assessment.

The information from these sources was evaluated to determine if it was relevant to the scope and scale of the question at hand, if it was accurate, and if it was reliable. High quality and valid scientific information was considered particularly valuable. This type of information is characterized by clearly-defined and well-developed methodology, logical conclusions, reasonable inferences, adequate peer-review, suitable quantitative methodology, proper spatial and temporal context, and the use of relevant and credible citations.

To be relevant, the information must pertain to the 15 topics under consideration at spatial and temporal scales appropriate to the plan area and to a land management plan. Relevance in the assessment phase means scientific information that is relevant to the conditions and trends of the 15 topics in 36 CFR 219(b), or to the sustainability of social, economic, or ecological systems (36 CFR 36 219.5(a)(1)).

Accuracy and reliability of relevant information was determined by comparing the scientific certainty and quality of the information, and using the most scientifically certain information available. Information from the chapter papers without appropriate supporting citations or references was considered to be less certain under the draft directives.

If the information appeared to be of comparable scientific certainty, then both points of view were carried forward and a data gap was identified as to the final conclusions. In this way conflicting information will be made available during public feedback opportunities, collaboration and the internal review process to verify and validate the information meets the criteria to be considered BASI. An assumption of the planning process is that public feedback will help ensure that relevant, accurate, and reliable information is considered.

Throughout the planning process, if competing scientific perspectives are found and it is an important planning issue, science review may be requested to critically evaluate the relevance, accuracy, and reliability of the competing information, and to determine the best available science to assist the responsible official in making planning-related decisions.

Key assumptions in determining BASI, in addition to those documented in the assessment, are documented in the administrative record. References included in this assessment reflect the most relevant documents, given the scope and scale of the assessment and determined to be BASI.

FINDINGS

Chapter 1: Ecological Integrity

Important Information Evaluated in this Phase

Ecological integrity is defined as the degree to which ecosystems are represented across the forest and functioning properly (Safford et al. 2012). For example, meadows are still well represented and are not substantially reduced in extent. Forests currently provide habitat for native plant and animal species at levels that allow them to persist.

In more technical terms, the 2012 Planning Rule draft directives define it as:

> the quality or condition of an ecosystem when its dominant ecological characteristics (for example composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence.

Biodiversity, or the living component, is central to ecological integrity. Most simply, it is the diversity of life.

More formally, according to the Congressional Biodiversity Act HR1268 (1990):

> Biological diversity means the full range of variety and variability within and among living organisms and the ecological complexes in which they occur, and encompasses ecosystem or community diversity, species diversity, and genetic diversity.

In this chapter, conditions and trends of ecological integrity are described and evaluated separately for the three major ecosystem types: terrestrial, aquatic, and riparian.

The primary data sources used were Forest Service databases. Additional information was compiled from the recent Sequoia Kings-Canyon National Park Resource Condition Assessment

(USDI 2013). Information was also taken from the April and July snapshots of Chapters 1 on the Living Assessment for the Bio-Regional and Sierra NF. Finally, substantial information was derived from literature reviews conducted by the Forest Service Pacific Southwest Region Ecology Program on the Natural Range of Variability of dominant vegetation types for the Bio-Regional Assessment (Safford 2013, Meyer 2013a and Meyer 2013b, Estes 2013, Merriam 2013, Gross and Coppoletta 2013). The Science Synthesis was developed for the Sierra Nevada by the Forest Service Pacific Southwest Research Station; individual chapters used included Hunsaker et al. 2013 and Collins and Skinner 2013.

Nature, Extent, and Role of Existing Conditions and Trends

These assessments focus on the current condition of the terrestrial, aquatic and riparian ecosystems of the Sierra NF. Current conditions, special habitats, biodiversity, ecological integrity, and natural range of variability for these three major ecosystems are assessed. All lands on the Sierra NF were included in this assessment. In some sections, broader patterns for the larger bio-region were also discussed.

Terrestrial Ecosystems

Land-based, or terrestrial ecosystems, change with elevation across the Sierra NF. At the lowest elevations, rising above the valley floor is the foothill zone which extends up to the montane zone. Ponderosa pine and mixed conifer forests dominate the montane zone. Next the upper montane zone is comprised of a mosaic of red fir forests, open Jeffrey pine woodlands, meadows, and montane chaparral. At the highest elevations, the sparsely vegetated subalpine and alpine zone occurs. Massive areas of rock outcrops occur throughout all of these vegetation types. Herbaceous plant species contribute most to plant species richness.

Foothill Zone

The foothill zone of the Sierra NF captures a small proportion of the western foothill belt which is mostly in private ownership throughout the Sierra Nevada. Because of this, the small amount of this biologically diverse vegetation type in public ownership is important for long term conservation. Mediterranean climate with long, hot summers, and cool, wet winters where most precipitation falls as rain (20-40 inches) is characteristic. Non-native grasses and herbs are dominant. Tree-dominated plant communities are blue oak woodland or savannah with foothill pine California buckeye, and interior live oak present to varying degrees.

Foothill landscape on the Sierra NF

The photo above shows a typical foothill landscape on the Sierra NF. In the foreground, open blue oak woodland (with 10-40 percent tree cover) over a green carpet of mostly non-native annual grasses is shown. The top of an evergreen live oak can be seen in the lower right corner. On the gentle hillslopes extending up into the middle of the photograph, large fields of orange, California poppies are visible on the south-facing aspects. On the north-facing aspects, the oak woodland extends up. Scattered on the tops of the slope and ridge are rock outcrops of granite.

The distinctive chaparral of eastern Fresno County is dominated by Mariposa manzanita, buckbrush, chaparral whitethorn, interior live oak, birchleaf mountain mahogany, western redbud, flannelbush, and yerba santa, with many other species adding to a highly diverse and special type of chaparral found only here. The relict, endemic shrub tree anemone has its natural range in the Sierra NF in this chaparral type, within a 225 square mile area.

Mixed Conifer Zone

Mixed conifer forest dominates the montane zone. It is comprised of: ponderosa pine, sugar pine, incense cedar, and white fir, and some Douglas-fir. Black oak is an important component of many mixed conifer stands, particularly at the lower elevations and on drier aspects (south and west). Knobcone pine, a fire-adapted, closed-cone tree, occurs in limited patches, such as near the Merced River. This zone is where the old forest associated California spotted owl, northern goshawk, and fisher occur most.

The photo below shows a mixed conifer forest near Nelder Grove at the higher reaches below upper montane red fir forests. A moderately dense (60-80 percent canopy cover) stand of white fir with scattered incense cedar and sugar pine are shown. In the foreground, a dense carpet of needle litter and scattered sugar pine cones are sprinkled with white fir and incense cedar seedlings. Scattered yellow bracken fern occur. Although not visible, this stand contains a population of the Forest Service sensitive species, the lady's slipper orchid (Cypripedium

californicum). The continuous litter layer and dense forest in the background are a result of long term fire suppression.

Mixed conifer forest near Nelder Grove

Upper Montane Zone

Upper montane forests occur above mixed conifer, where snow is the primary precipitation. Red fir forests with Jeffrey pine in the rockier sites occur. On more productive sites, western white pine is also found. In wetter sites, where the water table remains high in the summer, pure stands of lodgepole pine occur. Montane chaparral may cover extensive acreage in this zone, sometimes naturally on thin, rocky soils or in response to natural disturbances such as fire or avalanches. In many cases, shrub-dominated areas occur where sites have been logged or otherwise disturbed by forest management activities. Granitic outcrops are abundant in this zone as well, with many forest endemics and other rare plants.

Subalpine and Alpine Zone

The subalpine zone has stands of mountain hemlock and open, windswept pines. Whitebark pine is found in harsh, windswept areas of the alpine zone. The alpine zone is generally referred to as "above timberline" but may have *krummholz* or stunted trees, especially of whitebark pine. It supports a rich understory flora of over 600 species, 200 of which are limited to that zone (Sawyer and Keeler-Wolf 2007).

The photo below is of the John Muir Wilderness. It illustrates typical subalpine and alpine landscapes on the Sierra NF. In the foreground, low cover (1-30 percent) of herbs, grasses, and shrubs occurs among low granite rocks. Scattered stunted whitebark pine is intermixed. Around the lake in the center of the photo, there is a small rim of vegetated area, with sedges and rushes dominant. The rocky ridge in the background has sparsely vegetated talus and scree slopes.

John Muir Wilderness

Characteristics of Ecological Integrity

Ecological integrity is simple in concept to define, but more difficult in practice to assess.

A limited suite of ecosystem characteristics were selected to assess ecological integrity based on:

- information was readily available
- characteristic is relevant to key issues and sensitive to drivers and stressors
- characteristics represent elements not covered in other chapters

These included:

- natural range of variability of vegetation
- vegetation diversity (within-stand complexity, large trees, snags, habitat types)
- special habitats (e.g. aspen, complex early seral, old forest)
- fire as an ecological process
- connectivity (overall, old forest, and special management areas)

Natural Range of Variability

Under the 2012 Planning Rule, "natural range of variability" is a key means for gauging ecological integrity. Ecosystem sustainability is more likely if ecosystems are within the bounds of natural variation, rather than targeting fixed conditions from some point in the past (Wiens et al. 2012). Comprehensive, scientific literature reviews on natural range of variability were compiled. The following is an overview.

Consistent with trends across the entire assessment area, terrestrial ecosystems in the Sierra NF are predominantly outside the natural range of variability (NRV) for key indicators of ecological function, structure, and composition.

First, nearly half (44 percent) of the area of the Sierra NF dominated by woody vegetation (or 76 percent of montane coniferous forests) is in a highly departed condition with respect to the historic fire return interval, burning at frequencies that are significantly longer than pre-settlement fire regimes (Safford and van de Water 2013). The Sierra NF has missed an average of three to four fire return intervals across all vegetation types dominated by trees or shrubs (Safford and van de Water 2013). Subalpine forests are the exception, burning at intervals that within one or two fire return intervals.

Second, terrestrial ecosystems are experiencing increasing tree densities and canopy cover, especially shade-tolerant species at low to mid elevations. This pattern of increasing tree density and cover in mixed conifer and yellow pine forests are supported by extensive stand reconstruction studies at the Teakettle Experimental Forest (e.g., North et al. 2007, 2009) and neighboring Yosemite National Park (Scholl and Taylor 2010), and comparisons of early 20th century versus current stand inventory data (Meyer et al. 2013a) on the Sierra and Stanislaus National Forests (Lyderson et al. 2013 and Knapp et al. 2012).

The pair of photos below shows a comparison of historic (1929) and current (2013) stand conditions in a mixed conifer stand of the Sierra NF. This is taken from the original Dunning "Methods of Cutting" plot, used to illustrate forestry practices in the late 1920s. The photos were taken at an identical location and direction. In the top black and white picture taken in 1929, the forest is composed of a mixture of stand conditions (heterogeneity), including an open gap (foreground), dense clumps (background right), and moderately dense large trees (middle of photo). These include pine and fir trees. In front of the trees, the ground is open. Below the trees there are several large logs. In the background, a large snag is visible along with a variety of size from pole to overstory trees. In contrast, in the bottom color photo, taken in 2013, the forest is more uniformly dense and dominated by mid- and small-sized trees. The forest floor has a continuous litter layer covering it. Large logs are absent.

Historic (1929) and current (2013) stand conditions in a mixed conifer stand of the Sierra NF

Tree densities are also increasing in high elevation subalpine forests, based on information from immediately north of the Sierra NF (Dolanc et al. 2012). Species composition is shifting toward shade-tolerant species in low to mid-elevation forests and woodlands, favoring species such as white fir and incense cedar at the expense of shade-intolerant species such as ponderosa pine, yellow pine, giant sequoia and black oak. In contrast, subalpine forests are within NRV with respect to species composition (Dolanc et al. 2012).

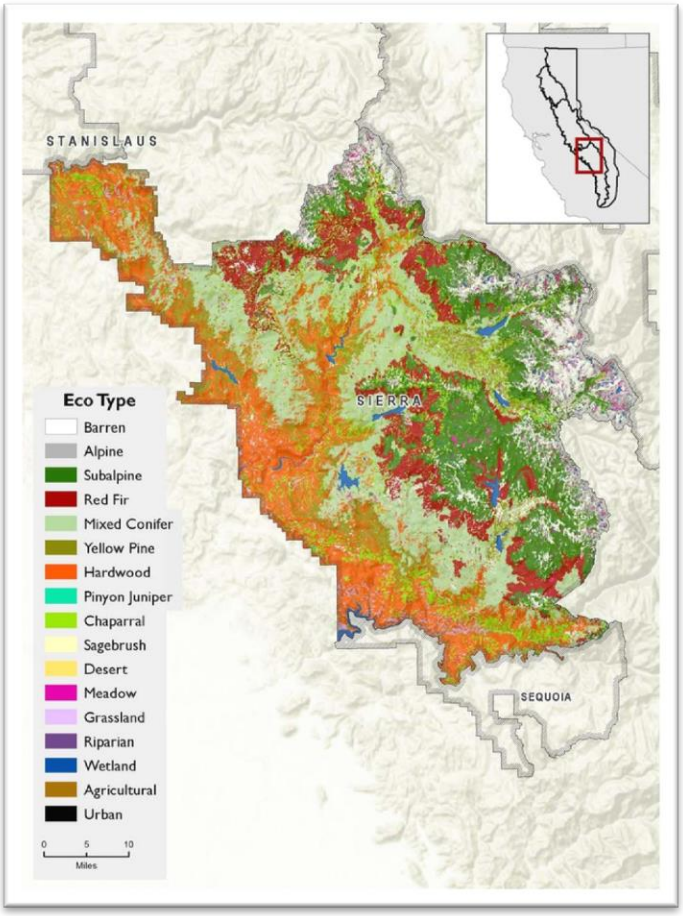
Terrestrial ecosystems of the Sierra NF are expected to experience dramatic changes in climate in the coming decades (Meyer and Safford 2013, Safford et al. 2012). Consequently, the future range of variation in climate exposure for these ecosystems will almost certainly exceed the NRV. Schwartz et al. (2013) evaluated future climate exposure to vegetation using downscaled climate projections for the southern Sierra Nevada, including the Sierra and Sequoia National Forests. Their results indicate a high proportion of all terrestrial ecosystems will be moderately, highly, or extremely vulnerable to future climate by the end of the century.

Vegetation Diversity: Type and Successional Stage

The California Wildlife Habitat Relationships (CWHR) classification system (CDFG 2008) was used as one way to characterize vegetation diversity. This comprehensive system is used throughout California's national forests, and it is the system is used here to provide an overview, or broad-scale filter, of habitats on the Sierra NF. It is based on dominant species, average size and canopy density. It is limited by lack of some key habitat characteristics (North and Manley 2012) such as shrubs, snags, large trees, or within-stand complexity, but is what is readily available. To supplement this information, other sources of existing data, especially from Forest Inventory and Analysis (FIA) plots were also assessed.

The Sierra NF contains 30 terrestrial vegetation types. The map below shows the range of CWHR types based on dominant species or vegetation type. Distinct bands of vegetation that change with elevation are evident. At the lowest elevations, orange areas dominate. These are hardwood, covering about one fifth of the forest. Interspersed are significant areas of light green, which are chaparral, particularly on south-facing slopes. Next, covering about one fifth of the forest is a

band of mixed-conifer forest and pine, depicted in light sage. Above that is a narrower band, about one tenth of the forest, colored brick. This is the upper montane forest which is dominated by red fir. Next, is a large band of dark green that represents an extensive area of subalpine forest, with co-dominance or dominance of lodgepole pine. At the highest elevations, along the crest, is a narrow band of alpine dominated vegetation. Throughout, especially in the upper montane areas and above, meadows occur in varying sizes but are not large in area.



Range of California wildlife habitat relationship types, based on dominant species or vegetation type on the Sierra NF

Habitats are further classified by combining the three CWHR criteria: vegetation type, size and canopy cover to create primary habitat types. The largest habitat coverage on the Sierra NF are mid seral coniferous forests (20 percent), hardwood and mixed hardwood -conifer forests (15 percent), late seral closed canopy coniferous forests (11 percent) and shrublands (10 percent).

More detail on combinations of average stand tree diameters and canopy cover categories is shown in the figures below. There are separate graphs for each ecological zone, including foothill, montane, upper montane and subalpine forests. The left axis of each displays the percentage of area occupied by each category, from 0 to 100 percent. The bottom axis displays different diameter categories from saplings (0-6 inch diameter), pole (6-11 inch diameter), small trees (11-24 inch diameter) and large trees (>24 inch diameter) from left to right. Each bar shows up to three canopy cover classes. The blue color is on the bottom and displays sparse to low canopies (10-40 percent cover). Next in the middle is red, which indicates moderate cover (40-60 percent cover). On the top is green, which denotes high canopy cover (>60 percent cover). Across the bottom, the acres for each combination of canopy cover (rows) and diameter size class (columns) are shown.

The top left graph is of forests in the lowest elevation, foothill zone. Most of the area (115,000 acres) is dense canopy cover with pole or small trees. A small portion (about 19,000 acres) has dense canopy and large trees and represents the hardwood-conifer forests at higher elevations and north or east aspects. Most of the remaining area has moderate canopy cover of pole or medium trees (-60,000 acres). The top right graph is of the montane forest, comprised of mixed conifer, ponderosa pine, and hardwood-conifer (black oak). The majority of this zone is in the medium diameter class (11-24 inch) and moderate to high canopy cover (160,000 acres). A substantial area is in dense canopy, large average tree diameter (93,000 acres). Most of the rest of the area is in low to moderate canopied pole size trees (40,000 acres). The upper montane zone occupies roughly half the area as the montane zone with similar patterns of size and density, except there is twice as much moderate canopy area of medium trees. This reflects the more open nature of higher elevation red fir and Jeffrey pine forests. Subalpine forests and woodlands cover the least area. A higher proportion of this zone is comprised of open, shrub, herb, and grass dominated or sparsely vegetated areas. The dominant tree size class is smaller, 6-11 inch, and 11-24 inch diameter, and the canopy is more open (20 percent or less) (55,000 acres). This is due to the harsh, higher elevation conditions and naturally more open subalpine woodlands.

Forest vegetation size/density for foothill, montane-dry, upper montane and alpine/subalpine zones on the Sierra NF

Vegetation Diversity: Large Trees and Snags

Large trees and snags are important to numerous cavity nesting and foraging animals including fisher, pine marten, California spotted owl, woodpeckers, flying squirrels, great gray owls, and many cavity nesting birds.

Overall, the number of large trees and snags are low and highly variable across all forest types. In all conifer types, there is less than 5 large trees (less than 30 inch diameter) per acre. In addition, the densities vary radically across the landscape as large trees are not evenly distributed. Most areas have a few large trees per acre and some patches, often previously disturbed (timber harvest or wildfire), don't have any and where they occur, they can be in clumps and patches across the landscape. Very large trees, trees more than 40 inch diameter, densities are even lower, typically less than one to two trees per acre. Again, many areas have no very large trees, and a few have some. In hardwood conifer and hardwood types, large tree levels are also somewhat low, with trees less than 24 inch diameter in the range of 4 to 6 per acre in conifer-hardwood forests. As expected, for oak woodlands that occur in harsher environments the levels are lower.

Large snags show similar patterns to large trees, but with lower densities and higher variation. Calculations of snags greater than 15 inches diameter show the range is from 1 to 4 snags per acre in conifer forests. As with large trees, the numbers are lower for conifer-hardwood, generally less than 3 snags per acre and numbers are calculated to be even lower in the oak woodland. Snags are especially variable in distribution with some patches containing large numbers from recent wildfires or where insects or disease killed groups of trees and other areas containing few dead trees. Large snags can stand for longer periods of time (decades) than smaller diameter snags (often less than a decade) and tree species and method of mortality also affects the decay and snag fall rates.

For more detailed information see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 1, lines 521-523.

Vegetation Diversity: Within Stand Structure

Heterogeneity is a term used to describe variable or patchy vegetation. North (2012) and others consider restoration of forest heterogeneity a major management goal. Previous discussion of increased forest density, lower large tree levels, support research that forests have become more uniform (North et al. 2009). This includes studies on the Sierra NF (North et al. 2007). North and Sherlock (2012) suggest using the coefficient of variation of stand structures as a way to measure the amount of "heterogeneity". Using the FIA data, the variation in basal area—the total cross-sectional area at 4.5' height of all trees, was calculated on the Sierra NF. Each plot consisted of 4 subplots. Almost all of the forest plots had coefficients of variation less than 100 percent, meaning they had low within-stand variation.

For more detailed information see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 1, line 520.

Special Habitats

There are some habitats that are less common, yet support a high level or specialized type of biodiversity. Information is limited on these habitats, but they are important to include. While not an exhaustive list, some of the special habitats noted on the Sierra NF include: old forest, complex early seral forest, rock outcrops, and giant sequoia groves. Most sequoia groves occur south of the forest and are encompassed in the Giant Sequoia National Monument. Their ecology and the characteristics of the species are addressed in the recent Sequoia National Monument Management Plan.

There are two giant sequoia groves on the forest, in the mixed conifer zone. Nelder Grove occurs in Mariposa County in the Fresno River watershed on the northern part of the forest, and McKinley Grove occurs in Fresno County in the Kings River watershed on the southern part of the Forest. They are impacted by fire exclusion, climate change, insects and disease, air pollution, and recreation. Increasing tree densities, fuel loading, and lack of fire have contributed to lower tree regeneration, and increased risk of high severity fire (Price 2000). Groves north of the main sequoia locations to the south in Kings-Canyon National Park, and the Giant Sequoia National Monument are considered important because of climate change that will increasingly stress trees to the south.

Rock outcrops support a variety of uncommon and often rare plants. These include limestone, metamorphic, gabbro, and granite rock outcrops. Plants associated with these habitats are described in Chapter 5 of this assessment. These areas are impacted by invasive plant species, habitat fragmentation, uncharacteristically frequent fire, surface mining, post-fire disturbance such as intensive grazing, illegal marijuana cultivation, and climate change.

Early seral vegetation includes areas where the vegetation is relatively young. In forests, this often means that instead of trees, sites are dominated by shrubs, herbs and grasses. Complex early seral forests are created by disturbances and contain residual legacies from previous older forests, such as large snags and logs. Although information pertaining to the proportion of early seral forest is lacking for the Sierra NF, these habitats may be less abundant compared to pre-European settlement conditions due to fire suppression and past forestry practices. Lack of these forests is a reflection of the decrease in forest heterogeneity described above. Large snags, large live trees and shrubs are the most common nesting habitat used by birds in the bio-region. A comprehensive map of complex early seral forests is not available. There is no comprehensive vegetation map that includes large snags and logs.

For more detailed information see the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 1, lines 976-1538, and the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 1, lines 172-235.

Terrestrial Animal Diversity

The Sierra NF is inhabited by approximately 302 species of terrestrial wildlife: 198 bird species, 82 mammal species and 22 reptile species. Chapter 5 of this assessment contains detailed information on species classified as federal threatened, endangered, proposed or candidate species under the Endangered Species Act. Species of conservation concern, their habitat, threats, condition, and trends are also covered in Chapter 5.

Connectivity

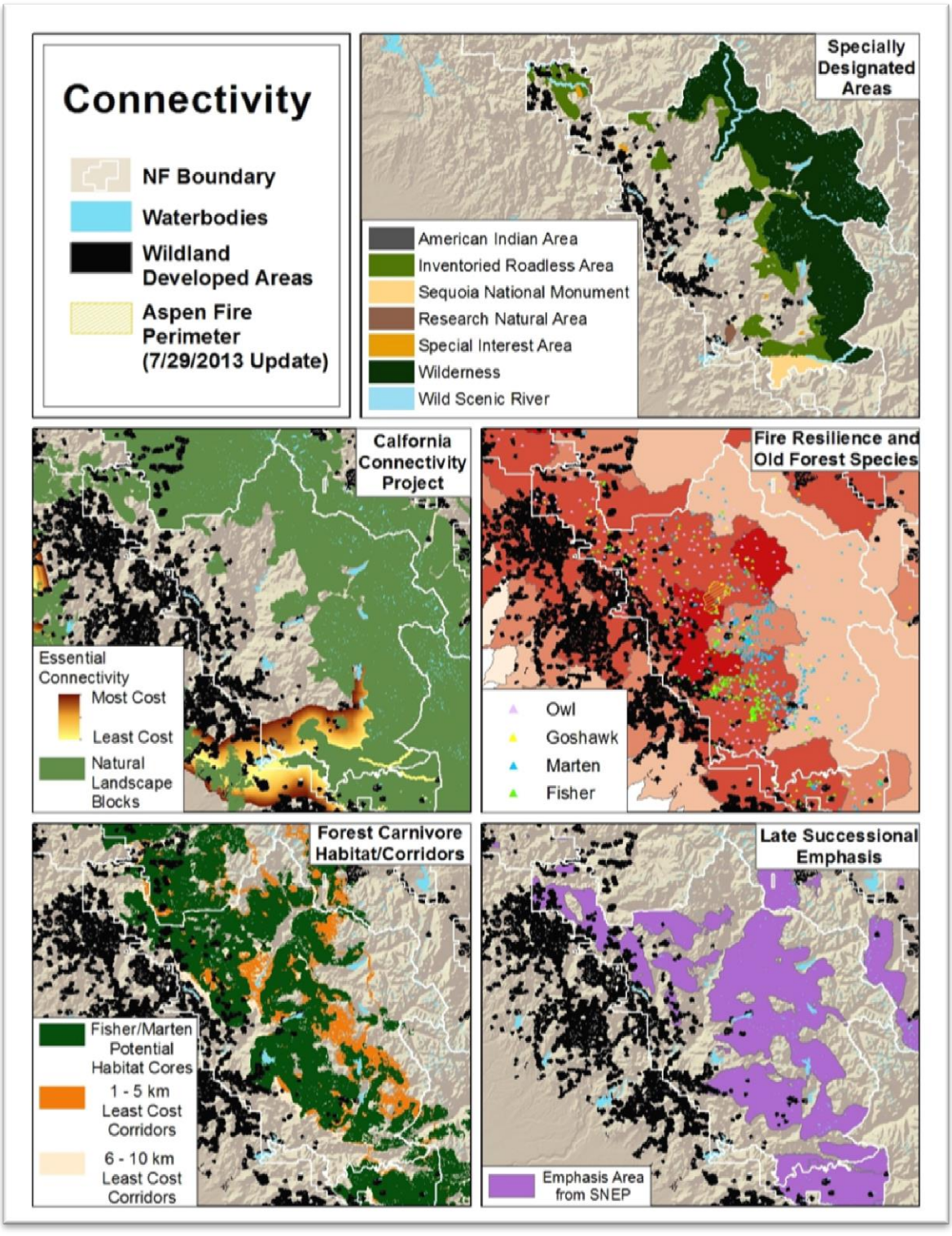
The ability for species to move throughout a landscape is important for ecological integrity. Species that are wide-ranging are able to maintain genetic diversity and sustainability in the face of changes to their population or environment. Connected landscapes allow other species to migrate in the face of climate change or other pressures. Existing information on connectivity across the Sierra NF and the bio-region include several sources: California “essential connectivity project corridors”; the fisher and marten habitat connectivity assessment (Spencer et al. 2012); special management areas; old forest emphasis areas from the Sierra Nevada Ecosystem Project (SNEP) (Franklin and Fites-Kaufman 1996); and distribution of multiple old forest habitat associated species in relation to landscape fire resilience.

The Sierra NF contributes greatly to connectivity in the bio-region for several reasons. First, there is no road that crosses the mountains on the forest. To the north, every national park and forest is bisected by one or more major transportation routes. From the Sierra NF south to Lake Isabella on the Sequoia NF, there are no roads across the crest of the mountains. Second, there has been an absence of large, forest stand-replacing fires for over 50 years. This may be in part due to the orientation of canyons in a way that does not align with prevailing winds, and the lack of roads across much of the higher elevations, limiting human caused fires. This situation will change as vegetation continues to get dense, fuels accumulate and climate warms. While lightening caused fires are part of the natural ecosystem, suppression of them has led to conditions that can result in large areas of high severity effects that may be detrimental to old forest species such as the fisher or California spotted owl. There is some uncertainty about the effects of fire severity on these species (Keane 2013 and Zielinski 2013). Modeling has suggested that large, high severity fires can have significant, negative impacts on fisher habitat quality and population size (Scheller et al. 2011, Thompson et al. 2011). But there have been no studies of actual fishers in burned landscapes in the Sierra. In addition, California spotted owls may occupy burned forest landscapes for breeding but primarily following low to moderate severity fires (Roberts et al. 2011). At the time of writing of this

draft, the Aspen Fire is burning on the Sierra NF. It remains to be seen what the distribution of fire severity is and what effects on wildlife will result from that fire.

The figure below shows five panels displaying key sources of information on connectivity. Each panel displays the Sierra NF. The boundary is depicted with a white line. The surrounding areas are draped over a topographically shaded relief map of the landscape.

On the top left panel is a legend with the following common map features: wildland developed areas, or where there are structures or infrastructure as large black dots; large water bodies are colored light blue; and the currently burning Aspen fire, shown as slanted yellow lines on the old forest species map. The top right map is of special management areas, and include: dark green for wilderness, occupying the upper one third elevations of the forest; adjacent to that in a strip to the west are inventoried roadless areas shown as moss green; light tan for the small area of the Giant Sequoia National Monument that extends onto the forest on the southern tip; and widely scattered, small patches shown as brown or rust that represent research natural or special interest areas. Several long stretches of wild and scenic rivers are shown in light blue, extending primarily in or next to wilderness and roadless areas. There is also one dark gray patch in the southern, mid-elevation area that is a designated American Indian Area. The second row is from the California Essential Habitat Connectivity Project on the left, and on the right are the locations of old-forest species (California spotted owl, goshawk, marten, and fisher) over landscape fire resilience index ratings. Most of these areas overlap with areas of low resilience to high intensity fire. See Chapter 3 of this assessment for further discussion of fire resilience. On the Sierra NF, the California Essential Habitat Connectivity Project overlaps with wilderness and inventoried roadless areas. The exception is on the south end of the forest, where a large swath between the foothills and higher elevation was designated as a potentially important area for moving between habitats. The least cost (yellow) area equates to the least barrier or impediment to movement by animals. The set of two maps on the third row display the forest carnivore habitat/corridors on the left and late successional emphasis areas on the right. These encompass similar areas and occupy large, almost continuous blocks, mostly below the wilderness and above the foothills at the western boundary. They occupy approximately half of the forest area and are predominantly hardwood-conifer, mixed conifer, pine, and upper montane red fir and lodgepole pine. The best (least cost) wildlife corridors are in orange and pink and fisher/marten habitats are marked in dark green.



Connectivity on the Sierra NF

Overall, connectivity of old-forest associated species is high, but vulnerable to uniform, high intensity fire during more severe weather conditions. Weather conditions conducive to intense fire are already increasing with climate change and are expected to increase more in the near and distant future. Connectivity of early seral habitat, particularly complex early seral habitat is unknown but likely limited due to fire suppression and past forest management.

For more detailed information see the July 18, 2013 screenshot of the Bio-Regional Living Assessment Chapter 1, lines 1539-2042.

Fire as an Ecological Process

Fire is a "keystone" ecosystem process in the bio-region and on the Sierra NF (McKelvey et al. 1996, van Wagtendonk and Fites-Kaufman 2006). This means that it is of key importance to ecosystem composition, structure, and function. Fire shaped the ecosystems.

Here, a brief discussion of fire as an ecological process and the implications of fire suppression are described. The patterns and history of fire on the Sierra NF and bio-region are discussed in Chapter 3 of this assessment.

Recurrent fire has shaped ecosystems of the Sierra Nevada (Skinner and Chang 1996). Many of the plants have fire adapted or enhanced traits, such as sprouting, thick bark, fire-stimulated flowering, or seed release or germination (Chang 1996, van Wagtendonk and Fites-Kaufman 2006). Many of these have been reduced in density or health. A notable example is black oak. It sprouts following fire and seedlings are resistant to low intensity fire. Currently, there are concerns about negative impacts of dense conifer cover around them, reducing their vigor, extent, and reproduction (USFS 2001). They readily form cavities and can be important for many species. Highly variable fires maintained patchy or "heterogeneous" vegetation structure and composition (North et al. 2009). This patchiness, along with enhanced plant growth from sprouting or fire-induced nutrient flushes, is thought to have provided diverse and productive habitat for many different plant and animal species. Animals currently associated with high density canopy, such as fisher or California spotted owl, may have previously been associated with more diverse vegetation that supported more prey (small mammals and birds) as well as cover. With fire suppression, this diversity has decreased. It is unknown how species would change with increased vegetation diversity (Keane 2013, Zielinski 2013). Further, one of the most important ecological effects of fire is to keep dead and alive vegetation, or fuels, variable and at lower levels. This means that when fires do burn, even under more severe weather conditions, they would burn less intensely and with more patchiness. This is not the case for much of the Sierra NF landscape at this time, which has experienced decades of fire exclusion.

One way to characterize the change is through estimates of "fire deficits". This can be characterized as the number of fire cycles missed. Van de Water and Safford (2011) computed a fire return interval deficit that is shown and described in Chapter 3 of this assessment. Most of the landscape has had a high departure in the frequency of fire compared to historic reconstructions. Another way would be to depict the time since last fire. This has not been completed at this time. There have been some active efforts to restore fire or some of the effects of fire through other vegetation management, but the pace and scale of those efforts is limited by several constraining factors including regulatory and institutional barriers (North et al. 2012). See Chapter 3 of this assessment for more detail.

More detailed information can be found in the July 18, 2013 snapshot of the Bio-Regional Living Assessment Chapter 3, lines 957-1013.

Aquatic Ecosystems

Rivers and Streams: Natural Range of Variability for Season and Inter-annual, Decadal Water Flow Patterns

Approximately 1,300,000 acres drain to the San Joaquin River system via the Merced, Chowchilla, Fresno and Kings Rivers, along with the mainstem San Joaquin River. Aquatic habitat includes an estimated 2,000 miles of perennial streams and rivers, along with 21,550 acres of lakes and ponds. Sierra NF aquatic systems provide habitat for 31 species of fish, with approximately 1,580 miles of stream occupied by fish. Perennial waters also provide potential habitat for a variety of amphibian and reptile species, as well as benthic macroinvertebrates. Additionally, there are 8,200 miles of intermittent or seasonal streams, some of which also provide habitat for fish, benthic macroinvertebrates and amphibians.

The El Nino Southern Oscillation is partially responsible for approximately a decade long inter-annual precipitation pattern in the southern Sierra Nevada. Drought years alternate with normal and extremely wet years during these decade long oscillations. In recent years the pattern has increased in variability. Within the same year, the Mediterranean climate has long dry summer periods with highly seasonal winter precipitation. In the past, the snowpack stored part of the winter precipitation into the drier summer months. A well-documented shift toward earlier runoff in recent decades has been attributed to a decreasing trend in snow precipitation and earlier snowmelt (Hunsaker 2013). The rain-snow interface zone is predicted to occur at higher elevations causing warming of streams earlier in the season. This warming will eliminate habitat for native cold water dependent trout. At the Kings River Experimental Watersheds (KREW), research to understand climate change effects for the southern Sierra Nevada is underway (Hunsaker 2013).

Aquatic Animal Diversity

Fish: The Sierra NF is within the Sacramento-San Joaquin zoogeographic province. Nine of the 31 fish species currently occurring on the forest are native, with most forest waters barren of fish prior transplanting activities starting in the late 19th century. Prior to 1850, the forest was occupied by eleven native fish species. Most of the waters on the forest are currently occupied by non-native fishes and the distribution of fish across the forest has been greatly expanded since the early 1900s. Native anadromous salmonids were eliminated from the San Joaquin drainages on the forest when a Fraint Dam was constructed just off the forest boundaries to supply water to the Central Valley. Native rainbow trout may have occurred up to 7,200 feet in elevation in the Middle Fork of the Kings River but transplanted trout appears to have eliminated this native. At lower elevation on the King River "pikeminnow-hardhead-sucker" assemblages would naturally have occurred. However dams on smaller river systems have eliminated much habitat for these species. Native fishes in California are considered to be imperiled by lack of connectivity of habitats, warming trends and other factors.

Amphibians: By the mid-1990s, six of the frogs and toads native to the forest showed severely declining populations. Three native amphibians are federally listed or candidates for listing and five others are potential species of conservation concern for the Forest Service. The declines of some amphibian species came with the introduction of fish into previously fishless areas. Introduction of non-native fish has

provided a predator in aquatic system that has disrupted the connectivity of habitat for amphibian species in particular. Recently air and water pollution, fish, non-native bullfrogs and Chytrid fungus have been implicated in the decline of these species.

Aquatic invertebrates: Aquatic invertebrates are a major source of food for birds, amphibians, reptiles, and fish. Changes in a food source of such importance as aquatic invertebrates can have repercussions in many parts of the food web. Aquatic invertebrates are affected by human caused activities on land and in water. Introduction of non-native fish has affected aquatic invertebrates in lakes and streams. Review of 40 benthic aquatic invertebrate datasets during the Forest Watershed Condition Assessment indicated 29 samples represented "functioning properly"; nine indicated "functioning at risk"; and two indicated "impaired" aquatic systems. The 155 miles of stream on the Sierra NF subject to minimum in-stream flows downstream of hydroelectric dams indicate impaired habitat for aquatic invertebrates. Reduced numbers of species, losses of endemics and native montane species occurs in the presence of trout.

Special Habitats

Meadows, springs, seeps, fens and lakes: The Sierra NF provides a diverse range of aquatic and riparian habitat types, ranging from low elevation ponds in chaparral woodland to glacial tarns near rocky alpine ridgelines. The elevation range results in a huge diversity of habitats and microclimates for a wide variety of aquatic and riparian species. There are an estimated 15,750 acres of meadow on the forest and 465,000 acres of riparian conservation areas (RCA) (USFS 2001 and 2004), associated with streams, meadows, springs and lakes. Meadows, seeps and springs in the drier southern Sierra Nevada provide important habitat diversity and habitat for plants and animals. Some meadows are considered to be in a degraded condition but not all are in poor condition.

Some montane meadows on the Sierra NF are experiencing increased conifer density and cover over the past several decades, although the degree of conifer invasion is highly variable across sites. Some meadows in the Sierra Nevada may be outside the natural range of variation with respect to the abundance of conifers and other woody plants (e.g., sagebrush) (Gross and Coppoletta 2013), which may affect the habitat quality for meadow-dependent wildlife on the Sierra NF. However, to date it is unclear whether these vegetation changes have affected the habitat use and population patterns of meadow-dependent wildlife. Meadows are also dependent on snowpack to sustain the water table throughout the long dry period of summer. As the rain-snow interface changes, lower elevation meadows will be increasingly at risk.

Fens are important because of their function in meadow water storage and their role in maintaining water quality and hydrologic integrity in meadows. Several sensitive plant species are found only in fens. Inventories of Sierra Nevada fens began in 2003, and are ongoing. The extent to which livestock grazing and trampling affect fens was investigated in a preliminary study (Cooper et al. 2005) and will continue to be studied in an attempt to determine the amount of such use fen ecosystems can sustain. These habitats will be altered by the changing timing of snow melt and overall precipitation.

The Sierra NF has many subalpine and alpine lakes in wilderness. Some lakes have remained pristine with no introduced fish and are being protected by wilderness designation. These lakes provide a last refuge for some amphibians. In previously fishless lakes, the effects of introduced fish on the food chain can be detrimental. Fish stocking is managed by the California Department of Fish and Wildlife. In addition, air pollution from the Central Valley or metropolitan areas may influence water chemistry.

Connectivity: Rivers, Streams, Reservoirs

There are 50 dams and diversions on the Sierra NF, which affect flow over approximately 220 miles of streams. Dams and diversions may contribute to aquatic habitat alteration by blocking fish movement or migration, and may contribute to species isolation. There are approximately 155 stream miles on the forest which are subject to flow regulation under licenses from the Federal Energy Regulatory Commission (FERC). Streams under FERC licenses have conditions for providing minimum in-stream flows. Water temperatures downstream of dams are affected by volume of flow and temperature of the upstream reservoir. Warming temperatures can further limit distributions of native fishes. While minimum flows can mitigate for temperature, they cannot change the barrier to fish migration.

Culverts on road crossings can also disrupt habitat connectivity by restricting upstream movement by species. Culverts may represent a total barrier to fish upstream movements, or force amphibians and reptiles to attempt road crossings that may subject them to mortality. It is estimated there are more than 14,700 crossings on the Sierra NF, with more than 1,500 of these crossings on perennial streams. The percentage of the culverts that provide for upstream passage is not known. However, in a limited analysis of perennial crossings on the forest during 2011, 88 of 121 crossings evaluated would not provide upstream passage for adult rainbow trout.

Invasive Species: Fish, Amphibians

Non-native fishes have been introduced or have invaded most waters of the range. These waters include extensive areas that were once fishless at high elevations. Sierra Nevada fisheries have largely shifted from native fishes, especially salmon and other migratory fishes, to introduced fishes. These non-native fish outcompete and feed on the native species in these lakes, including insects, frogs, and fish. In previously fishless lakes, the effects on the food chain can be detrimental.

Non-native bullfrog has become widely dispersed across the forest at elevations below 5,500 feet. Bullfrogs are larger than native frogs and may be both a competitor for habitat and a predator. Much of the potential habitat for California red-legged frog and foothill yellow-legged frog is not occupied by bullfrog. However, its range is expanding into the lower elevational distribution of mountain yellow-legged frog.

The New Zealand mud snail has caused significant disruptions in stream food chains across many trout streams of the western United States. Due to high numbers of aquatic species found only in the Sierra Nevada, invasive herbivores like New Zealand mud snail can have strong influences on invaded ecosystems.

Ecological Integrity

The dominant biodiversity characteristics of aquatic systems on the Sierra NF indicate that stressors outside the natural range of variation have influenced fish and amphibians which cannot withstand and recover from most perturbations imposed by human influence, or are outside the natural range of variability. Connectivity, past land management, disease, pollution and other stressors limit the biodiversity of the forest aquatic systems. Water quality and quantity are within the natural range of variability in most areas of the forest. However, climate change is a stressor which may limit water quality and quantity in the future. Overall, watersheds are in good condition, most are able to recover from most perturbations imposed by human influence or within the natural range of variability. A few are

impaired due to water withdrawals or impoundments. However, invasive species, fire, and climate change remain stressors on watershed condition.

Riparian Ecosystems

Natural Range of Variability: Vegetation and Fire and Fluvial Processes

Riparian meadow and non-meadow plant communities are formed by the interacting effects of flood frequency and intensity, soil saturation and depth of water table, proximity to the channel, the height above water level, sediment deposition, and ice scouring. Riparian non meadow areas include both woody species of shrubs and trees, as well as herbaceous grasses, grass-like species, mosses, and ferns (Fites-Kaufman et al. 2007). These non-meadow, riparian settings generally have shallower soils, or occur more often on steeper slopes, have higher coarse fragments (rocks) in the soils, and lower water holding capacity of soils than meadows. Riparian vegetation along streams varies considerably on the forest, ranging from clearly defined bands of riparian forest dominated by white alder, willow, and Oregon ash to simply a strip of herbaceous riparian plants with upland forest trees growing next to the stream throughout much of the conifer forest belt. There is little scientific information available on biodiversity of non-meadow riparian areas, but some studies have been conducted on the Forest, especially by scientists contracted by hydroelectric companies for relicensing of hydroelectric facilities (e.g. Taylor and Davilla 1985).

Fire suppression, and other management that limited fire in riparian zones, has had a direct effect on the composition and structure of riparian vegetation. Fires naturally spread into riparian areas, although sometimes in different ways and frequency than into adjacent uplands. Lack of fire creates less patchiness, less diversity of plants and structure, and fewer associated animals. Increased conifer and overall vegetation density and uniformity in the riparian area result in higher-intensity fires across large areas, sometimes across entire watersheds or basins. Information on the ecological role of fire in riparian areas, Native American fire management, and current observations to very high intensity fire at times suggests they are resilient to low and moderate intensity fire, and that ecological integrity is enhanced by low to moderate intensity fire. Over the next century, climate change is predicted to alter hydrologic regime, precipitation patterns and the role of fire in riparian areas. Restoration of flow regimes on regulated rivers, fluvial processes and ameliorating high temperatures are important restoration goals for riparian ecosystems. Natural floods inundate healthy floodplains allowing for the growth of native seedlings; equally beneficial are the flows that remove riparian vegetation. The fluvial process is movement and deposition of sediment by water and is a natural result of seasonal changes in water flow (Allen 1995). In upper watersheds, there may be opportunities to restore floodplain connectivity, especially in meadows, consistent with social needs for clean water and ecological benefits.

Vegetation Structure and Integrity

Riparian non-meadow areas include those areas where woody plant species are dominant over herbaceous species in the riparian zone. Condition of riparian non-meadow areas, like other riparian areas, is determined by functional and structural characteristics. Structural characteristics that are important in riparian systems include the proportion of conifer to hardwood cover, canopy layering, canopy cover, and bare ground. Condition of these non-meadow riparian areas is often summarized by comparing existing tree densities, stand age class distribution, and understory composition with historical or “natural” conditions. Riparian non-meadow plant communities are dominated by aspen, willow, and alder trees; and

in steeper drier areas lodgepole pine, and Ponderosa pine. Riparian vegetation and its structure are influenced across the landscape by topography, soils, stream channel activity, precipitation patterns, grazing, flooding, wind and fire. This highly variable spatial structure provides habitat and resources for a selection of understory plants, fungi, and invertebrates found in riparian areas across the forest. Annual fluctuations in flows and precipitation resulting from El Niño influences may have a significant influence on riparian tree establishment and understory diversity. Riparian vegetation is subjected to frequent wildfire disturbances.

Over the next century, climate change will alter hydrologic regime, precipitation patterns and the role of fire in riparian areas. Fire history in riparian areas appeared similar to that of the surrounding areas. However, post fire seedling recruitment and sprouting allowed riparian vegetation to be resilient. Riparian ecosystems are naturally resilient, provide connectivity among habitats, and create thermal refuge for fish and wildlife. Whether these valuable ecosystem services can adapt to changing conditions will be dependent on location. Common riparian species such as alder or willow can be sensitive to temperature. As these species migrate to higher elevations; more productive species from warmer areas could be planted to maintain these important wildlife habitats to increase resilience. Since the diverse community includes endangered and sensitive species, movement of these plants might be a viable option. An important key indicator is the presence and extent of non-native plants which indicate the extent of riparian degradation, or health/integrity.

Special Habitats

Aspen: Aspen is a broad-leaved tree that occurs in diverse habitats on the forest, from wet areas to subalpine rock talus. It occurs most commonly around meadows and streams in the upper montane red fir and lodgepole pine forests. Although it currently occurs in less than 1 percent of the assessment area, it supports very diverse understory plant and bird communities. Several bird species of management interest are associated with aspen including northern goshawk, red-breasted sapsucker, warbling vireo, and mountain bluebird. Aspen distribution is greatly reduced compared to pre-European settlement, and many stands are in poor condition due to conifer encroachment and poor regeneration. Estimates suggest its extent in western North America has been reduced by as much as 96 percent, primarily because of fire suppression and historic overgrazing. Fire is also important in aspen stands because it kills young conifers that shade out light-loving aspen. Mule deer use aspen stands to feed in and the lush vegetation in aspen stands cover for fawning. Grazing by domestic livestock, sheep and cattle increased dramatically in the mid-1800s and had a dramatic effect on aspen and meadows in general. Aspen sprouts, or regeneration, are favored browse. Reduction in aspen regeneration was noted in the early 1900s (Sampson 1919). Fencing can result in higher aspen sprouts. In the intermountain west, decreased aspen growth has already been attributed to higher temperatures and extended drought. Annual fluctuations in available soil moisture resulting from El Niño influences on snow pack depth may have a significant influence on establishment of plants.

Early seral vegetation: In riparian areas, sites are dominated by shrubs, herbs and grasses. Complex early seral forests are where there are residual legacies from previous older forests, such as large snags and logs. In the past fire, drought, and wind combined to create openings in the canopy, creating patches of early seral habitat across the landscape. In riparian areas, willows and alders can colonize these openings. Snags and shrubs are the most common nesting or resting habitat used by birds, reptiles and amphibians. However, fire suppression has altered these processes of habitat creation and succession beyond the natural range of variability. Without fuels management in riparian areas and a return of controlled fire to

the landscape, the patchy nature of a natural landscape will be less likely to withstand and recover from most perturbations imposed by human influence or that are outside the natural range of variability.

Understory Plant Diversity

One of the most important ecological effects of fire is to promote sprouting of hardwood shrubs, trees, herbaceous flowering plants, and grasses that otherwise have a difficult time competing with densely canopied conifers that shade them out. However, fuel management has been constrained in riparian corridors due to concern for water quality and sensitive riparian ecosystems. Riparian zones are among those areas most impacted by non-native invasive species. An important characteristic is the presence and extent of non-native plants which indicate the extent of riparian degradation, or health and integrity.

Animal Diversity

Riparian communities contain more plant and animal species than any other California community type and about one fifth of terrestrial vertebrate species in the Sierra Nevada depend on riparian habitat. About one quarter of wildlife species that depend on riparian habitat are considered at risk of extinction today. Connectivity of habitats is important for migratory birds as well as amphibians and reptiles that use riparian areas. Species such as the willow flycatcher, Sierra Nevada Yellow Legged frog, and Great Gray Owl depend on different aspects of riparian habitats and openings in meadows.

Obligate riparian bird species showed strong declines in population since 1868. As of the mid 1990s, half of the 32 amphibian species, and almost half of the 40 fish species/subspecies found in the Sierra Nevada were endangered, threatened, or of special concern. Additionally, 85 percent of Sierra Nevada watersheds are characterized as poor to fair for aquatic biotic communities, including amphibians and fish.

Connectivity

While 93 percent of studied watersheds in the Sierra Nevada have clear gaps in the riparian corridor especially in lower elevation areas, many of the riparian corridors are in steep canyons and forested slopes on the Sierra NF. Roads, road crossings, timber harvest, private lot clearing, livestock grazing, and dam and diversion dewatering can all block connectivity of habitat for dispersal of seeds and wildlife.

Ecological Integrity

The dominant biodiversity characteristics of riparian ecosystems on the Sierra NF indicate that stressors outside the natural range of variation have influenced birds and amphibians which cannot withstand and recover from most perturbations imposed by human influence, or are outside the natural range of variability. Connectivity, past land management, disease, pollution and other stressors limit the biodiversity of riparian ecosystems. Water quality and quantity are at present well within the natural range of variability in most areas of the forest. However, climate change is a stressor which may limit water quality and quantity in the future. Watersheds are overall in good condition, and most are able to recover from most perturbations imposed by human influence or are within the natural range of variability. A few are impaired due to water withdrawals or impoundments. However, invasive species, fire, and climate change remain stressors on watershed condition.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

In 2004, the Forest Service produced the National Report on Sustainable Forests (USFS 2004). It included a summary of the current condition of forests, based on a variety of ecological, social and economic indicators of sustainability. Much of the information came from Forest Inventory and Analysis (FIA) plots, satellite-based vegetation maps, and national economic and social monitoring of national forests.

The following table summarizes the findings from this report, including current conditions and trends for sustainability characteristics.

Findings from National Report on Sustainable Forests

Characteristic	Condition Bio-Regional Assessment (2013)	Condition Forest Assessment (2013)	Trend
Ecosystem Diversity			
Extent of area by forest type and successional stage or age-class	Low levels of old forest and possibly early seral. Low levels of within-patch diversity.	Moderate levels of old forest, possibly low levels of early seral. Low levels of within-patch diversity.	Trend to maintain except with warming climate, high possibility of increased high intensity fire that could decrease old forest and increased early seral habitat. Unknown effects on within-patch diversity- could increase with managed fire and restoration.
Extent of area in protected areas	High in southern half of bioregion at high elevations.	Low at low and mid-elevations, high at higher elevations (wilderness).	Unknown.
Fragmentation of Forest Types	Low for most possible fragmentation of early seral, especially complex early seral.	Low for most, high fragmentation of early seral, especially complex early seral.	Increase fragmentation for old forest and decrease for early seral with expected changes in climate and fire.
Species Diversity			
Number of forest-dependent species	See Chapter 5		
Status of species at risk (legal status*)			

Genetic Diversity			
Species with range contraction	Fisher contracted. Some locations of owls affected by concentrations of recent high intensity fires All native fish and amphibian species	Unknown.	Unknown. Aquatic species populations are declining for a variety of reasons; climate change will further stress these species.
Invasive Species	Unknown.	Unknown.	

Overall, continuous vegetation cover is present but within-patch diversity is greatly reduced from estimated historic conditions. This is largely due to fire suppression and past forest management, which has also resulted in high forest and vegetation densities, and very high surface fuel loads. These conditions, in combination with current and future warming and drying climate trends, is leading to high vulnerability to uncharacteristically, large, uniformly high intensity fires. This could result in fragmentation of old forest habitat currently used by species of concern including the California spotted owl, fisher, and marten. It will have unknown effects on the extent and quality of early seral vegetation.

Historically, riparian and aquatic ecosystems were valued for their economic uses, including transportation corridors, water supply, electricity, construction materials, waste disposal, settlement, agriculture and livestock. Riparian areas are extremely important sources of shade, food, and refuge during high flow events for aquatic organisms. Biologically, both aquatic and riparian areas provide special habitat for some endangered or threatened species, refuge and water for upland species, corridors for species movements, and thermal refuge for aquatic species.

Information Gaps

Ecological integrity is difficult to characterize, as described above. Additional characteristics may be developed in the future. Limited or missing information or gaps in our knowledge are described below.

Terrestrial Ecosystems

Some aspects of ecological integrity have much information, such as the location of fisher, marten and California spotted owl. However, many aspects of their habitat and use of that habitat are unknown. In particular, the spatial distribution of large trees and snags are unknown. The location and amounts of complex early seral forest are unknown. It is unknown how fisher, marten, California spotted owl and goshawk respond to restoration treatments. It is unknown how other animals are distributed or affected by restoration treatments or vegetation diversity such as black-backed woodpecker, songbirds or small

mammals that the carnivores and raptors depend on. Moreover, the condition and trend of many high elevation species sensitive to climate change is unknown, such as whitebark pine and alpine chipmunk.

Aquatic and Riparian Ecosystems

In the face of climate change, restoration of aquatic ecosystems in order to promote resilience of aquatic ecosystems is needed; however it is not known which systems are at the highest risk or highest priorities. Predictions under climate change are that water and air temperatures will warm and precipitation patterns will change. It is not known how quickly this change will occur or the potential effects on plants, lichens, and wildlife. The key plant and wildlife characteristics to evaluate wetlands and streams are not known. The tradeoffs between landscape scale consideration of managing riparian areas for fire and methods for fuels management in riparian areas are not known. While there is some data on habitat characteristics for native warm water species, it is unknown how these species respond to flows on regulated rivers.

Chapter 2: Assessing Air, Water, and Soil Conditions

Important Information Evaluated in this Phase

Key Air Conditions

Airsheds

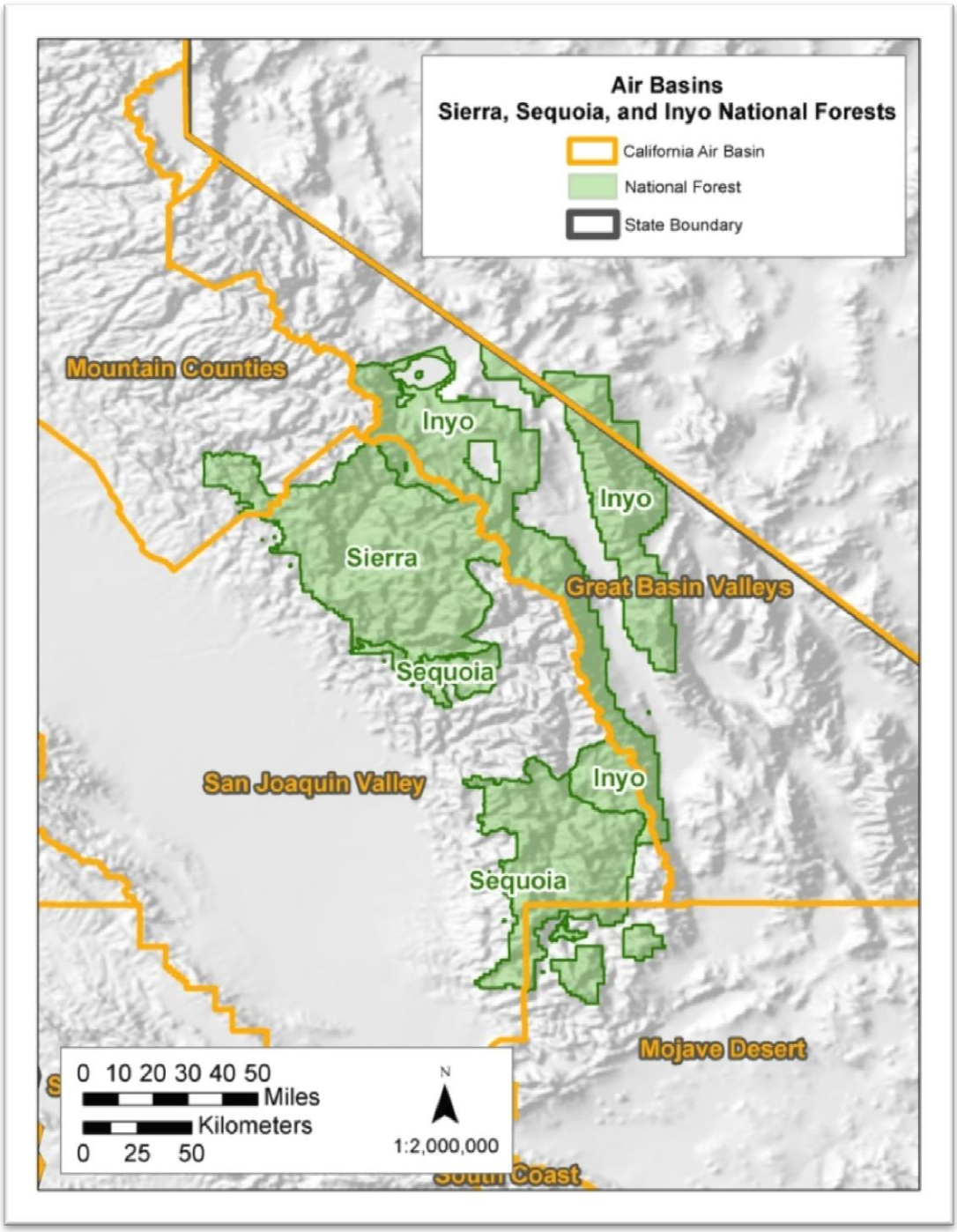
The two Air Pollution Control Districts (APCDs) within the Sierra NF are the San Joaquin Valley Unified APCD and the Mariposa County APCD. The air basins which cover the forest are the San Joaquin Valley Air District and the Mountain Counties Air District. The Forest Service must meet all regulations of the air districts.

Location and Extent of Sensitive Air Quality Areas

Lands under extra protection are called Class I and apply to wilderness or national parks which were larger than 5,000 acres and were in existence in 1977. The Ansel Adams, John Muir, and Kaiser Wildernesses are Class I areas on the Sierra NF. Particulate matter (PM) is divided by matter less than 10 micrometers (PM_{10}), and matter less than 2.5 micrometers ($PM_{2.5}$). The forest has lands federally designated as non-attainment for ozone and a maintenance status for PM_{10}. California standards are stricter than federal standards, resulting in non-attainment for ozone, $PM_{2.5}$ and PM_{10}.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 2, lines 52-94.

The map below shows the location and boundaries of air districts on the Sierra, Sequoia, and Inyo National Forests. The primary dividing line runs along the crest of the Sierra Range, between the Great Basin Unified to the east of the crest, and the San Joaquin Valley to the west. Within the basin on the west, there are two air districts that encompass the Sierra NF. Ninety percent of the forest falls in the San Joaquin Valley Unified Air District. A small area that juts out on the northwest corner of the forest falls in the Mountain Counties Air Basin.



Location and boundaries of air districts on the Sierra, Sequoia, and Inyo National Forests

Relevant Emission Inventories, Trends, Conditions

Total emissions by pollutant type for the Mountain Counties and San Joaquin Valley Air Basins 2010

Total emissions by pollutant type (tons per day)	Mountain Counties	San Joaquin Valley
Total organic gases	519	1635
Reactive organic gases	410	361
Carbon monoxide	977	1272
Nitrogen oxides	66	524
Sulfur oxides	6.1	23.7
Particulate matter (PM2.5)	242	539
Particulate matter (PM10)	167	302

There is a general north to south trend of pollution with the Sierra Nevada bio-region. Air quality in the north near the Modoc NF is generally good. Air quality declines toward the south. The Central Valley of California and the surrounding mountain ranges act as a 'bowl' trapping pollution in that valley. The Sierra NF is the eastern boundary of this Central Valley bowl.

Secondary Pollution - Ozone

Ozone is a secondary pollutant, which means it is not directly emitted to the atmosphere. It is formed through chemical processes induced by sunlight exposure in the presence of other pollutants. Ozone injury of vegetation was established in the late 1970s to late 1980s throughout the Sierra Nevada (Bytnerowicz et al. 2013). No critical loads for ozone have been established. An index of ozone exposure was created to better understand how ozone impacts vegetation communities. All of the Sierra NF is modeled as high vegetation exposure to ozone.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 2, lines 95-150.

Smoke Emissions

Smoke from fires affects the air quality on the Sierra NF. These impacts are short term, meaning that smoke from fires can be severe but impacts are limited to when fires are actually burning. Smoke often impacts more than a single basin as it can move long distances from its source. Local air districts have established regulations to minimize the impacts of smoke from prescribed fires.

Critical Loads

Critical loads are defined as a concentration of air pollution or total deposition of pollutants above which specific negative effects may occur. The lower western slope of the Sierra NF exceeds airborne nitrogen deposition critical loads (Bytnerowicz et al. 2013). Airborne nitrogen could have effects on nitrogen cycling, water quality, tree health, biodiversity, and sensitive indicator species, including lichens (Bytnerowicz et al. 2013).

As the distance from the Central Valley increases, the assessed condition improves. Areas on the eastern edge of the Sierra NF are modeled as not exceeding ecosystem critical loads.

Visibility

Air pollution has decreased on the Sierra NF. The overall trend in air pollution is decreasing because visibility is increasing. However, levels still exceed regulatory and healthy ecosystem limits in many locations.

Below are two pictures of the Ansel Adams Wilderness. In the picture on the left, the mountains across the center of the photo can be seen clearly. There is an obvious lower half of the slope covered with forest and the ridge tops by a skyline of jagged, rocky peaks. The photo on the right was taken on a low visibility day of the exact same location. In this photo, the mountain range is barely visible and the entire picture looks like it has a dark gray film on it.

Two pictures of the Ansel Adams Wilderness showing visibility

For more detailed information on air quality conditions see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 2, lines 44-247.

Key Soil Conditions

Geology and Geomorphology and Other Factors Important to Ecological Integrity and Soil Quality

The Sierra NF has a wide variety of soil types. These soils vary in the parent material, climate, topography, vegetation, and degree of development. Most soils are primarily derived from granitic and metamorphic bedrock. There are also soils derived from glacial till and meadow sediments. Topography varies widely, with the lower elevations (1,000 to 7,000 feet) having steep slopes and being more highly divided into drainages and ridgelines. The higher elevations tend to have gentle basins and moderate slopes. Warmer temperatures, sufficient precipitation, and gentle topography create great conditions for soil development at the middle elevations (5,000 to 7,500 feet). Soils are less well developed at higher (more than 7,500 feet) because of lower temperatures and a shorter growing season. At lower elevations (less than 5,000 feet), a lack of precipitation and a pronounced summer drought limit soil development.

These differences result in a broad range of soil productivity across the Sierra NF. The most productive soils are found at middle elevations on the western side of the forest up to about 6,500 feet in elevation.

Mixed conifer vegetation, including ponderosa pine, west side mixed conifer, and the few giant sequoia groves on the forest are located throughout these soils. These areas are the section of the forest that has seen the most logging and resultant soil disturbance. Soils at higher elevations (7,000 to 12,000 feet) in the colder soil temperature regime tend to be shallower, less well developed, and coarser textured.

Current Inventories of Soil Conditions and Improvement Needs

Estimates of sediment delivery provide a general means of assessing soil conditions, especially erosion. Two different approaches were used to estimate sediment rates: sediment accumulation in reservoirs, and road densities and published sediment delivery rates. A general discussion of relative differences in sediment delivery from different land management activities and wildfire is also included. Maintaining soil in place is paramount to current and future soil quality, resilience, and health. Recovery of severe erosion is beyond human timescales (Moghaddas et al. 2013).

Based on sediment accumulations in the Crane Valley and Teakettle No. 1, Hume, and Pine Flat Reservoirs sediment yields ranged from 0.11 to 0.9 tons per acre per year. All of these estimates come from the early 1990s to the late 1940s, except Pine Flat. At Pine Flat, the estimate was from 1952 to 1956 and was the highest at 0.9 tons per acre per year. All sediment yields are relatively low, and are well within the range for forested lands in the western United States. Forest management activities or severe fire can increase erosion of soils (Moghaddas et al. 2013). It is unknown how sedimentation rates on the Sierra NF changed with active timber management between the 1940s, 1990s and the present.

Planned fuel reduction or timber projects result in lower long term erosion rates than experienced following wildfires (Moghaddas et al. 2013). Wildfire is inevitable if fuel loads are not reduced (Collins and Skinner 2013). The soil loss on a skid trail is greater than in the areas between skid trails, and the loss following a wildfire is much greater than in an undisturbed forest (Moghaddas et al. 2013).

Forest roads are one of the major sources of sediment on national forests in California. Road decommissioning is the most effective approach to reducing road-related sediment delivery. However, for roads necessary for forest management and recreation, road maintenance including storm proofing, is the primary means of controlling erosion. Declining budgets have reduced the ability of the national forests in California to maintain and stormproof roads.

On the Sierra NF, there is an estimated 1,969 miles of road across just over 1.3 million acres. The estimated sediment yield from these roads is between 0.01 and 0.09 tons per acre per year. Estimated road-related sediment yields overlap the low end of the range of reservoir sediment yields. This comparison indicates that roads are likely to be substantial sources of sediment in some actively-managed forested watersheds with overall low sediment yields. This comparison also shows that road-related sediment cannot account for a majority of sediment from high-yield watersheds. Other sources of sediment therefore also need to be considered in planning effective activities to control sedimentation.

Selected land uses on the Sierra NF

Land use	Sediment yield, tons per acre per year
Background, from reservoir sedimentation	0.11 to 0.9
Wildfires (1 to 3 years post fire) (Forest Service Pacific Southwest Regional value)	30 to 44
Vegetation management*	0.0004 to 0.004
Forest roads (with typical BMPs)	0.01-.09
Livestock grazing*	0.09

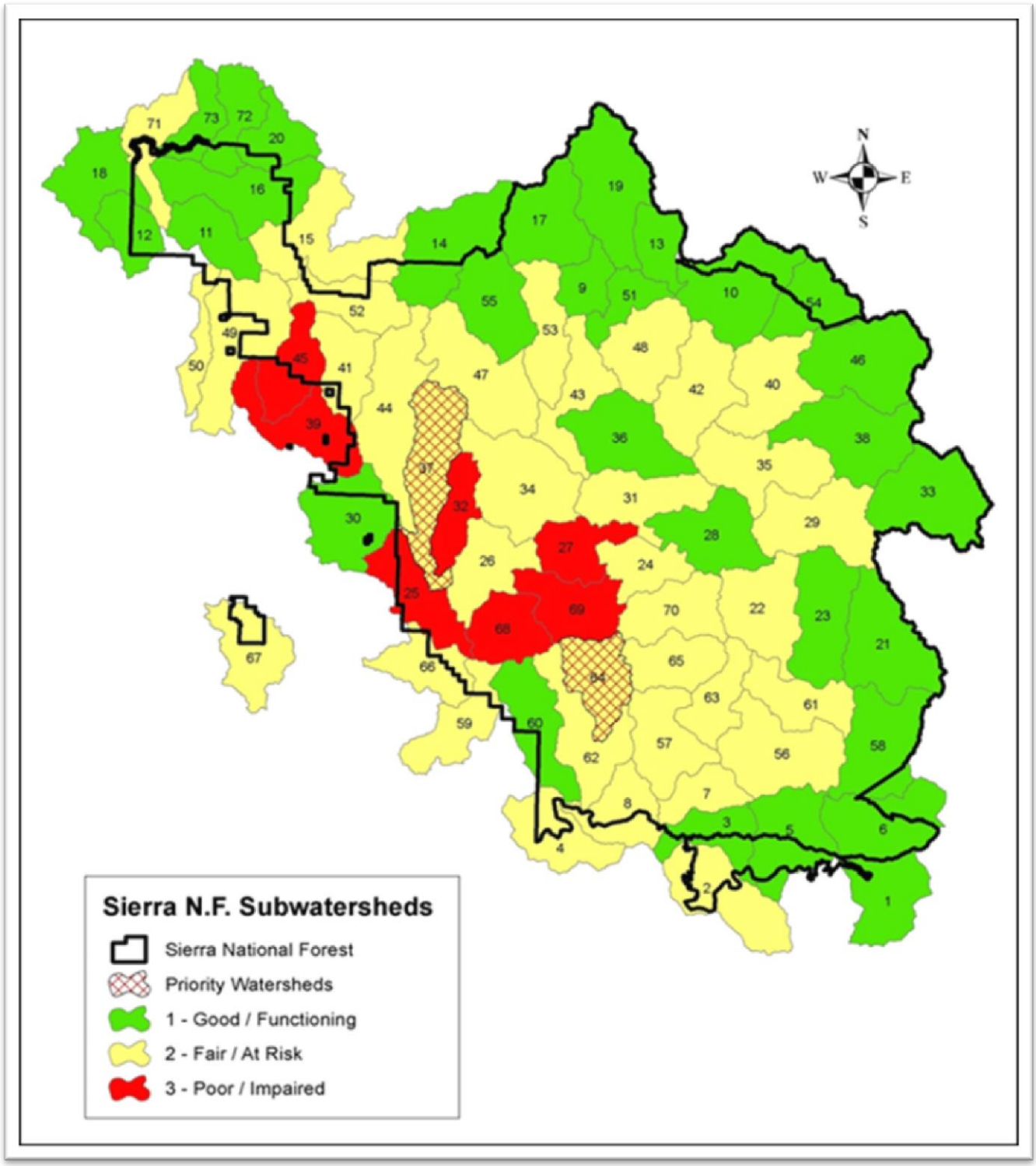
For more detailed information on soil quality conditions see the July 2, 2013 snapshot of the Bio-Regional Living Assessment Chapter 2, lines 249-270.

Key Water Conditions

Watershed Conditions and Impaired or Contaminated Waters

Connectivity of aquatic habitat on the Sierra NF is altered by 50 dams and diversions which affect flow over approximately 220 miles of streams on the forest. Properly functioning watershed conditions create and sustain functional terrestrial, riparian, aquatic, and wetland habitats capable of supporting diverse populations of species. The forest completed a Watershed Condition Assessment (USDA Forest Service 2010). Twenty-five watersheds were properly functioning or good (43 percent of forest drainage), 33 watersheds were functional at risk (52 percent of forest drainage), and seven watersheds were defined as having impaired function (5 percent of forest drainage). Habitat fragmentation, flow alteration, exotic species, road density, and road proximity to water were the most common stressors affecting watersheds that were in less than good condition.

The following map shows watershed condition on the Sierra NF. The black outline is the forest boundary. Watersheds at higher elevation are in good condition and shown in green, or fair condition and shown in yellow. Those in poor condition are shown by red and are found associated with dams and water diversions at lower elevations. Priority watersheds for restoration actions are indicated by crosshatch, and are close to or include watersheds that are in poor shape.



Sierra NF sub-watersheds

Approximately 465 miles of perennial stream channel were evaluated to rate channel type and stability. Stream reaches composed of bedrock or boulders had low sensitivity to management activities and made up about 60 percent of the streams evaluated. Fifty four percent of the moderately sensitive channels had poor channel stability. Understanding thresholds of erosion beyond which long term sustainability is jeopardized requires extensive monitoring and understanding of reference conditions and natural variability (Hunsaker 2013).

Water Quantity, Quality, Timing and Distribution of Water Resources

Aquatic habitat includes an estimated 2,000 miles of perennial streams and rivers, along with 21,550 acres of lakes and ponds. There are 283 seeps and springs and 3,849 meadows on the Sierra NF and adjacent areas. Lakes, streams and rivers abound. No major river or stream on the forest is undammed. High quality water from the forest is delivered to reservoirs for distribution to agriculture and communities. Water yield from the forest was 2,560,000 acre-feet per year in 1986 and 2,651,940 in 2009.

Water quality impairment is associated with dams, especially Pine Flat Reservoir and Willow Creek. The 303(d) List of Waters reports on streams and lakes identified as impaired for one or more pollutants; the term 'impaired' means these water bodies do not meet one or more water quality standards and require a total maximum daily load (TMDL). Impaired waters are identified through assessment and monitoring programs conducted by volunteer networks and other local, state and federal agencies. A segment of Willow Creek was added to the 303(d) list in 2006 for failing to meet the water temperature objective. Summer water temperature from approximately 200 sites suggests that the transitional zone between cold and warm water habitat may be influenced by minimum instream flows, and that smaller streams above 3,000 feet elevation are currently cool enough for trout. Water temperatures in larger streams may be influenced by limited riparian shading, especially in streams flowing through bedrock canyons.

Alteration of flow paths from roads can affect meadow and wetland function, with the effects extending far beyond the area of the road itself (Hunsaker et al. 2013). A local study in the Kings River Experimental Watershed found that 13 percent of the road length in the study area allowed streams that they crossed to be connected on either side of the road. The Sierra NF works at the project scale to identify and reduce instances of roads blocking stream connectivity, but general principles for upgrading or decommissioning roads has been developed (Hunsaker et al. 2013).

Potential effects from cattle grazing, for instance altering channel function, can alter natural processes, habitat diversity and habitat complexity for aquatic or riparian animals. Animal wastes could directly impair water quality through contamination and increasing nutrient levels, although over 90 percent of the samples in a recent study met USEPA's current criteria for Fecal Indicator Bacteria and nitrate, orthophosphate, dissolved oxygen, temperature, or pH were well below levels of ecological concern according to a study evaluating grazing effects on water quality. However, recent studies of the effects of grazing on water quality are not in agreement (Roche et al. 2013).

Historic Context under which Hydrologic Systems Developed

Major floods in the Sierra Nevada occurred in 1861-62, 1906, 1909, 1955, 1964, 1986, 1997, and 2005. Based on these dates, the frequency of large floods may be increasing. Flooding leads to additional erosion and sedimentation.

Nature, Extent and Role of Existing Conditions and Future Trends

Many uses for water from the forest compete. These conflicts mean that there isn't enough water for all user groups. Climate change is expected to reduce the supply, and may increase the competition for water use. Development and population growth will put even more demand on the available water. California counties within the bio-region are expected to increase in population by 69 percent, with the highest growth in Fresno, Kern, and Tulare Counties.

Climate predictions for California include increased warming, less snowpack, and earlier spring snowmelt. These changes would influence the amount of water supply that can originate from forest lands and from precipitation. Uncertainty about the water supply makes planning for distribution of water in the future challenging.

Consumptive Uses

Eleven reservoirs on or adjacent to the Sierra NF have a total capacity of 2,388 acre feet of water. Twenty-two operationally active hydroelectric facilities on the Sierra NF use either reservoirs or are run off the river. Most of the runoff from the northern Sierra NF is carried by the San Joaquin River to Millerton Lake at Friant Dam, where it is stored and diverted via the Central Valley Project which is operated by the Bureau of Reclamation, north through the Madera Canal and south through the Friant-Kern Canal. Annual diversions from the forest average 1.29 million acre-feet. A 2004 federal court ruling specified that 800,000 acre-feet per year to the river will be released for the San Joaquin River Restoration Plan. This will have a severe impact on entitlements delivered through the Friant-Kern and Madera Canals. Water rights and entitlements delivered through the Madera and Friant-Kern Canals are extremely important to the economy of the San Joaquin Valley.

Non-Consumptive Uses

Water plays a major role in providing a diverse set of recreation opportunities on the Sierra NF. The Sierra Nevada ecosystem is the setting for a large recreation and tourism industry, and for new homes built for the influx of people who enjoy living here. The upper San Joaquin River has potential for habitat for spring and fall for many species including chinook salmon, steelhead, green sturgeon, Sierra Nevada and Foothill foothill yellow-legged frog, California red-legged frog, and the Western western pond turtle..

Nature and Distribution of Federal and Non-Federal Water Rights

The Sierra NF has 1,110 water right filings. These uses of these water rights include but are not limited to recreation, fire protection, road maintenance, wildlife, domestic, stock watering and power production. Tribes throughout California have rights to access adequate supplies of water for direct consumption, agricultural purposes, or protecting existing resources. Tribes may have senior water rights and some water sources may be defined as sacred sites.

Effects of Land Use, Projects, Activities, and Other Stressors on Hydrologic and Geomorphic Processes and Water Resources

Dams and hydroelectric projects disrupt the connectivity of streams and rivers, preventing fish from migrating up or down river to stay within temperature tolerances. High flows needed to scour sediments and provide fish access to floodplains for feeding are suppressed below reservoirs. Climate predictions indicate that changes in flow patterns will stress meadows, streams and rivers in several ways. Peak flows will be earlier and more intense, possibly increasing erosion and leaving less water later in the summer (Hunsaker et al. 2013). Increased erosion will mean more soil loss at a rate higher than background. These possible changes will have consequences for the people, plants and wildlife that depend on these systems. Restoration of meadows and their streams will be important in the coming years to maintain hydrologic functioning at mid to high elevation meadows (Hunsaker et al. 2013).

Ecological, Social, and Economic Roles Water Resources Play on Broader Landscape

Streams and rivers are used for water supply, irrigation, transportation, hydropower, waste disposal, mining, flood control, timber harvest, and recreation. Many of these uses have made aquatic and riparian systems the most altered and impaired habitats of the Sierra Nevada. As the population of California has grown, so has the demand for water, leading to greater diversion and de-watering within Sierra Nevada riparian systems. The synergistic impacts of the declining water table depth due to expected increasing human demand, coupled with more climate variability from climate change, will likely mean further degradation of watersheds and will threaten ecological sustainability.

The Sierra Nevada ecosystem produces approximately $2.2 billion in commodities and services annually. Water accounts for more than 60 percent of that total value (Hunsaker et al. 2013). Predicted population increases in the state can result in more people benefiting from these water and power commodities and services. Conflicting uses for water can result in rising costs for this resource. The trend in this value is increasing and will continue to increase in the future. Most of the water value accrues to water right holders and beneficiaries outside of the bio-region.

For more detailed information on water conditions see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 2, lines 277-549.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

There are two different ways that sustainability of air, water, and soil were addressed. The first was a general comparison of current conditions relative to the natural range of variability. Information is very limited on the natural range of variability of air, water, and soil. Second, a first approximation of conditions of key sustainability characteristics from the National Report on Sustainable Forests (2004) was made. Human and ecosystem health are affected by pollutants from the Central Valley and the San Francisco Bay Area (Bytnerowicz et al. 2013). On the other hand, smoke from fires is far less prevalent than it was thought to be historically. Smoke would have affected haze and visibility, but would not have had negative impacts on vegetation. It could have impacted Native Americans living in the vicinity when it was more severe. It is likely that severe levels were less common since fires were more frequent and less intense overall.

Soil has been modified in some areas and in others is largely intact. In the lower and mid-elevations, mining, logging, and associated roads have altered soil structure and organic matter. At higher elevations, little or no change in soils has occurred. Overall current soil conditions are fair to good, but are at risk because of dense vegetation and fuels that support high intensity fires, resulting in a very high potential for soil erosion.

The major rivers that originate on the Sierra NF are, from north to south: the Merced, the Chowchilla, the Fresno, and the San Joaquin. In the early twentieth century, dams were developed for irrigation, hydropower generation and drinking water on each of the major rivers and on some of the tributaries. These dams support the most productive agricultural counties in California. Clean water for drinking, irrigation, and hydropower generation is highly valued among communities and farmers of the San Joaquin River Valley. However, unforeseen costs including loss of the iconic salmon from the San Joaquin River complicate the assessment of current conditions. Sustainability of high quality water is at risk from increased erosion as a result of more flooding associated with predicted climate changes. Quantity and timing of water is vulnerable to changes in climate. Snowmelt is occurring earlier than it did 20 years ago.

Much of the information used to estimate the conditions in the table below came from the National Inventory and Analysis (FIA) program. This is a nation-wide network of systematically placed inventory plots.

Characteristics of sustainability from the National Report on Sustainable Forests (2004)

Characteristic	Condition	Trend
Area subjected to levels of air pollutants that may cause negative impacts to ecosystems	Majority of air basin affected	Levels of some pollutants have decreased slightly but major changes not expected.
Area of forest land with significant soil erosion	Small, site specific areas.	Could increase dramatically with single high intensity fire.
Percent of stream length in which stream flow and timing have deviated significantly from natural range of variation.	Larger rivers deviate significantly from natural range of variability in stream flow, connectivity and timing of flows. Snow melt is two weeks earlier in the last 10 years.	Connectivity is not expected to improve over next 10 years; timing of peak flows is predicted to occur earlier every year. Snow melt will continue to occur earlier.
Area and percent of forest land with significant compaction.	Small, site specific areas.	Not expected to change, except increased recreation use could increase.
Area of forest with significantly diminished soil organic matter and/or changes in soil chemical properties.	Unknown.	Could increase dramatically with single high intensity fire, over long term continuous loading of Nitrogen from the air could influence soil productivity and chemical properties.
Percent of water bodies with significant variance of biological diversity from NRV.	Many frogs and toads have been lost from lower elevations. Many native fish are blocked from movement up large rivers. Birds dependent on meadows	Active management to improve conditions would be required to preserve biodiversity.

Characteristic	Condition	Trend
	have been in decline. Nonnative fishes in reservoirs move into native warm water species habitats and have potential to outcompete the natives.	
Percent of water bodies with significant variation from historic levels of chemistry and temperature.	Several rivers and their reservoirs are impaired for temperature.	In conjunction with predicted warming and lower flows this is not likely to improve over next 10 years.
Area and percent of forest land with an accumulation of persistent toxic substances.	Significant levels of N are deposited into the forested lands and water. To date lichens are showing effects but soils do not appear to be effected yet.	Unknown response time.

Information Gaps

Air

Although ozone exceeds regulated levels and some ecosystem damage has been observed, ecosystem critical loads have not been developed (Bytnerowicz et al. 2013). There is also a need for improved tools and models on air quality associated with prescribed fire and wildfire during different conditions (Bytnerowicz et al. 2013). This would improve planning and evaluation of treatments to reduce uncontrolled wildfires. At this time, only broad and general assessments can be conducted.

Soil

Comprehensive surveys of soil condition are lacking. Information is site specific to management activities. Information regarding soils from the National Forest Inventory and Analysis (FIA) plots on the Sierra NF is not readily available but would be highly useful for evaluating sustainability. Mastication of wood during thinning can produce deep residues, and how this could impact rates of nutrient cycling, nitrogen availability, or soil aeration is not known. Fire treatments in masticated stands may result in more severe effects to soils. No long term studies exist to address these issues. It is not known how sedimentation rates on the forest changed with active timber management between the 1940s, 1990s and the present.

Water

There are gaps in information regarding:

- effects of long term nitrogen deposition on nutrient cycling in streams
- effects of fire on water quality at low and moderate levels of fire
- cumulative landscape level effects of fire on water quality and quantity

- uncertainty of climate change
- uncertainty about landscape level and long term effects of cattle and other livestock on water quality, sustainability and improvement of biodiversity of meadows and streams, riparian vegetation structure (for meadow birds and amphibian), thermal cooling of streams (for fish, amphibians, and macro invertebrates), and lateral floodplain inundation
- accurate estimates of the timing and distribution of snowmelt

Chapter 3: Assessing System Drivers and Stressors

Drivers and stressors are recurring events, processes or actions that affect ecosystems. These effects are important to ecosystem condition. For example, fire used to and can play an important role by keeping understory plants at lower levels and thinning understory trees. It used to and can create variation in habitat which is important for biodiversity. In these ways, it is a "driver" of ecosystem condition. Fire is a stressor when it is large, uniform, of high severity and outside the natural range of variation. The context in which fire occurs is also important. For example, because old forest habitat is limited and some associated species like the fisher are of concern, extensive high severity fire in these areas has great impact.

Other important drivers and stressors are insects and pathogens, invasive species, climate change, and land use or management. Effects of these are addressed in the appropriate chapters of this assessment. For example, the effects of climate change and fire on terrestrial biodiversity are covered in Chapters 1 and 5 of this assessment.

Important Information Evaluated in this Phase

All lands of the Sierra NF were included in this assessment. In some sections, broader patterns for the larger bio-region were also discussed. For more detailed information on drivers and stressors in the bio-region see the July 2, 2013 snapshot of the Bio-Regional Living Assessment Chapter 3. Additional information was also obtained from the Natural Range of Variability Assessments (Safford, Sawyer, Merriam, Meyer, and Estes 2013). Finally, information was drawn from several of the Science Syntheses compiled by the Forest Service, Pacific Southwest Research Station (Bytnerowicz et al. 2013, Collins and Skinner 2013, and Hunsaker et al. 2013).

Nature, Extent and Role of Existing Conditions and Future Trends

The drivers and stressors that exert primary influence on terrestrial ecosystems and people were selected and characterized in this assessment. These are: climate change, air pollution, fire, insects/pathogens, vegetation succession and management, and invasive species. Water development is an important influence on aquatic ecosystems and is covered in Chapters 1 and 2 of this assessment. Grazing is an important influence on riparian areas, and is covered in Chapters 2 and 8 of this assessment. Impacts to people are covered in Chapters 6 through 14 of this assessment.

Climate Change

Climate change is a key landscape stressor affecting long term ecological conditions. It is expected that air temperatures and precipitation patterns may change across the forest over time. The forest

encompasses a wide span of elevational zones that are typically characterized by warm, dry to hot summers and cool, wet winters. Most precipitation above 5,500 feet falls in the form of snow from fall through spring. Change in climate is expected to be reflected through an increase in daily maximum, minimums, and mean air temperatures, along with altered rainfall precipitation patterns. Meyer et al. (2012) and Safford et al. (2012) examined fire trends presented in Miller et al. (2009), and incorporated long term weather stations data within or adjacent to the Sierra NF (~4,000 to 7,000 feet elevation) and found that mean annual temperature at Huntington Lake has increased by between 2.5 and 3.6 degrees Fahrenheit, with a mean minimum (nighttime) increase of 3.7 to 7.6 degrees since 1915. Increases in temperature were especially apparent at higher elevations (higher than 7,000 feet elevation) (Diaz and Escheid 2007). Using information projected by Meyer and Safford mean annual temperature increases by 0.3 degrees, mean annual minimum temperature increases by 0.4 degrees, and mean annual maximum temperature increases by 0.19 degrees over the 10-year period at Huntington Lake, which is at 7,000 feet. Freezing months declined by approximately one to three months over this same period. In contrast, precipitation has either not changed or increased slightly at higher elevations (Meyer et al. 2012).

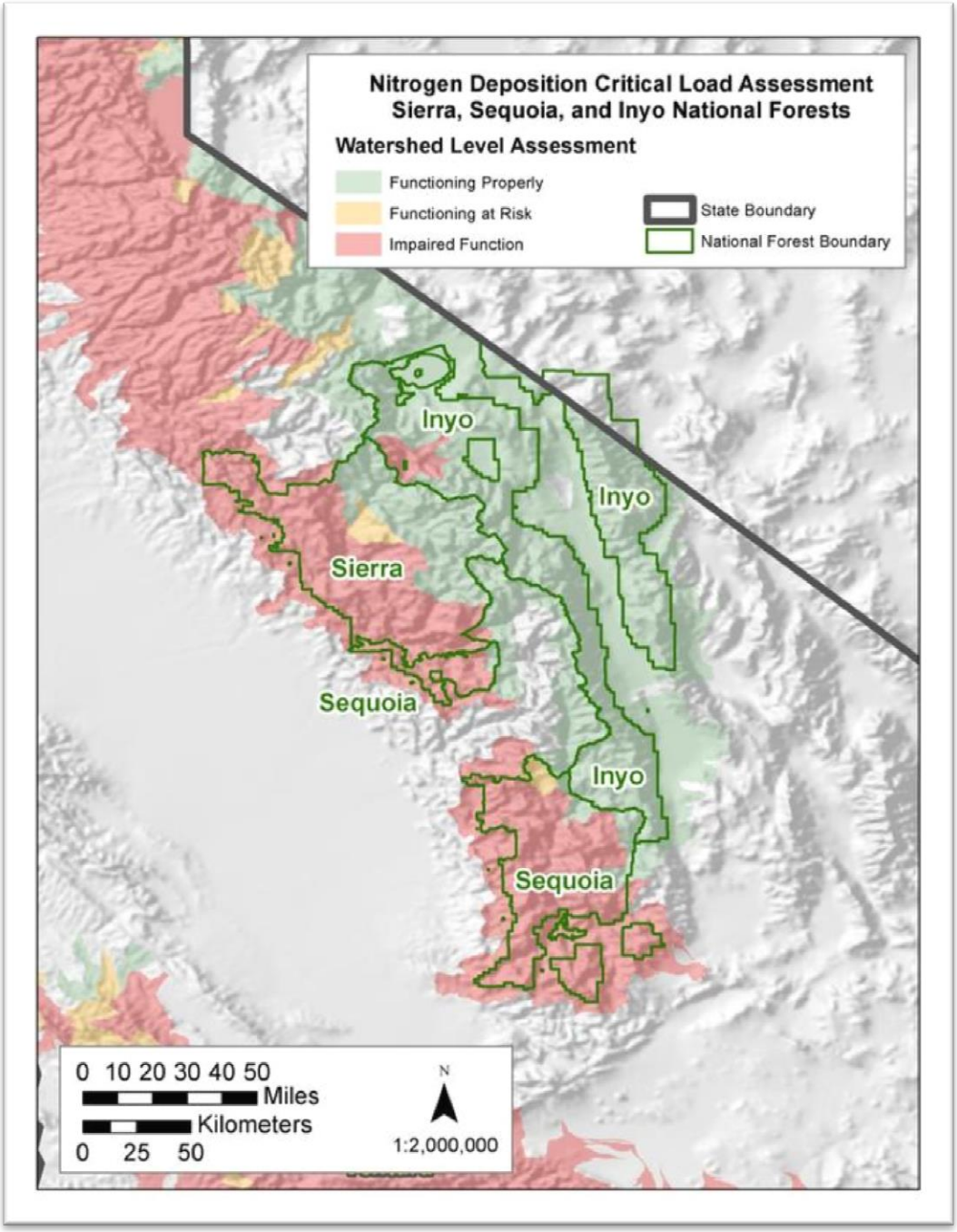
Most recent climate models project temperature increases by about nine degrees Fahrenheit in California by the end of the 21st century, with precipitation remaining similar or slightly reduced compared to today (Dettinger 2005). Most models also agreed that summers will be drier than they are currently, regardless of levels of annual precipitation. In the southern Sierra Nevada, including the Sierra NF, climate models, on average, project an average 7.5 degrees Fahrenheit increase by the end of the century with no change or a slight decrease in precipitation (Gonzalez 2012, Thorne et al. 2013). Most models also project a continuously increasing rain-to-snow ratio and earlier runoff dates for the next century, with decreased snowpack (late winter snow accumulation decreases by 50 percent by 2100) and growing season stream flow even in the higher elevation river basins of the Sierra NF (Miller et al. 2003, Moser et al. 2009).

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 1, lines 810-824.

Air Quality

Chapter 2 of this assessment contains detailed information on air quality and pollution for this assessment, based largely on the scientific synthesis on air quality by Bytnerowicz et al. (2013). Here, emphasis is on those aspects that affect ecosystems. This includes impacts to vegetation and ecosystem critical loads. Critical loads are defined as a concentration of air pollution or total deposition of pollutants above which specific negative effects may occur. Critical loads are based on ecosystem responses rather than regulatory guidelines (Pardo et al. 2011). When critical loads are exceeded, ecosystems are at risk of being damaged. The range of damage depends on the concentration and length of pollution exposure. Ozone and nitrogen are the primary pollutants that currently affect ecosystem condition. They are stressors.

For ozone, critical ecosystem loads or thresholds have not been developed. Bytnerowicz et al. (2003) calculated an exposure index. They reported that the Sierra NF has a high vegetation exposure to ozone. For nitrogen, low and mid-elevations of the Sierra NF have been modeled as exceeding critical loads for the ecosystem.



Nitrogen deposition critical load assessment for the Sierra, Sequoia and Inyo National Forests

The above map shows results of a nitrogen critical load assessment on the Sierra, Sequoia, and Inyo National Forests. The red color displays areas where critical load for nitrogen deposition is exceeded. The lands surrounding the Central Valley are most affected by nitrogen deposition. A little more than half of the western Sierra NF exceeds the critical load. The remainder does not and covers the higher elevation, subalpine and alpine areas. This pattern is similar to the rest of the bio-region, except the Sequoia National Forest which is virtually completely impacted.

Increased exposure to nitrogen has been linked to negative ecosystem impacts such as increased invasive plant populations, altered lichen communities, and altered mountain lake chemistry with elevated nitrogen deposition rates in California (Fenn et al. 2010 and Weiss 2006). Soils are buffering excess nitrogen, limiting excessive nitrogen inputs to streams (Hunsaker et al. 2013).

For more detailed information on air quality and its impact to ecological sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 2, lines 141-184.

Fire

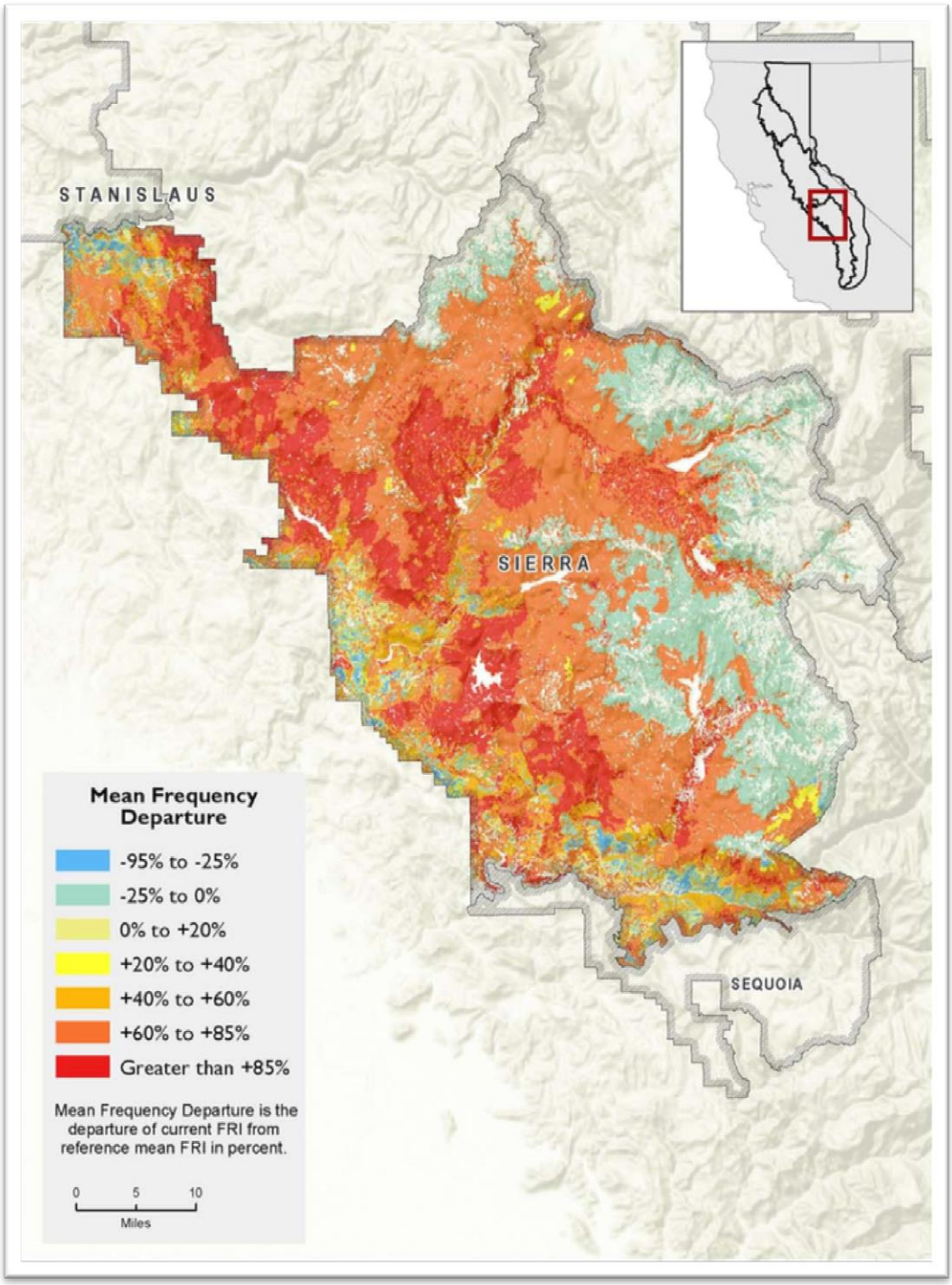
Fire has a major influence on ecosystems and communities in the bio-region and on the Sierra NF. Fire has always been a fundamental ecosystem process, shaping the landscape in the bio-region. In the past, it was more extensive, widespread, and less intense. Over 100 years of fire suppression has led to detrimental effects to ecosystem integrity. At the same time, the lack of fire has increased fuel loads causing an increased risk of detrimental effects to communities and resources from too much high intensity fire. There are many controversies surrounding how to define issues related to fire and how to address them. Fire suppression, European-settlement activities, the wildland urban interface (WUI), and climate change have vastly changed the patterns of fire, and the ecological, social, and economic consequences of fire (Husari et al. 2006, Collins and Skinner 2013).

Prior to European settlement, fire was widespread throughout the Sierra NF and bio-region (van Wagtendonk and Fites-Kaufman 2006). Frequency, spatial pattern, and severity varied by ecosystem. The variation by ecosystem and the ecological role of fire was described in Chapter 1 of this assessment. There have been two primary changes to fire patterns in the past 50 years. First, the overall frequency of fire across the landscape is greatly diminished from historic patterns. Second, the extent of high severity fires has increased beyond what is desirable by most.

Van de Water and Safford (2011) compared current fire frequencies with historic fire frequencies. The map below shows the mean frequency departure for the Sierra NF, expressed as percent of departure in classes. The classes include:

- -95 to -25 percent areas that have more frequent fire
- -25 percent to 0 or 0 to 25 percent + areas that have little to no deviation in fire
- 20 to 40 percent + areas with some fire deficit
- 40 to 60 percent + areas with high fire deficit
- 60-85 percent + or >85 percent + areas with a very high fire deficit

These latter areas are colored orange and dark orange on the map. They encompass over 80 percent of the landscape at low and mid-elevations. This means that fires occur much less frequently now than historically. An exception to this is at the highest elevations, in subalpine and alpine areas, where there is little to no change.



Difference between current and historic fire frequencies

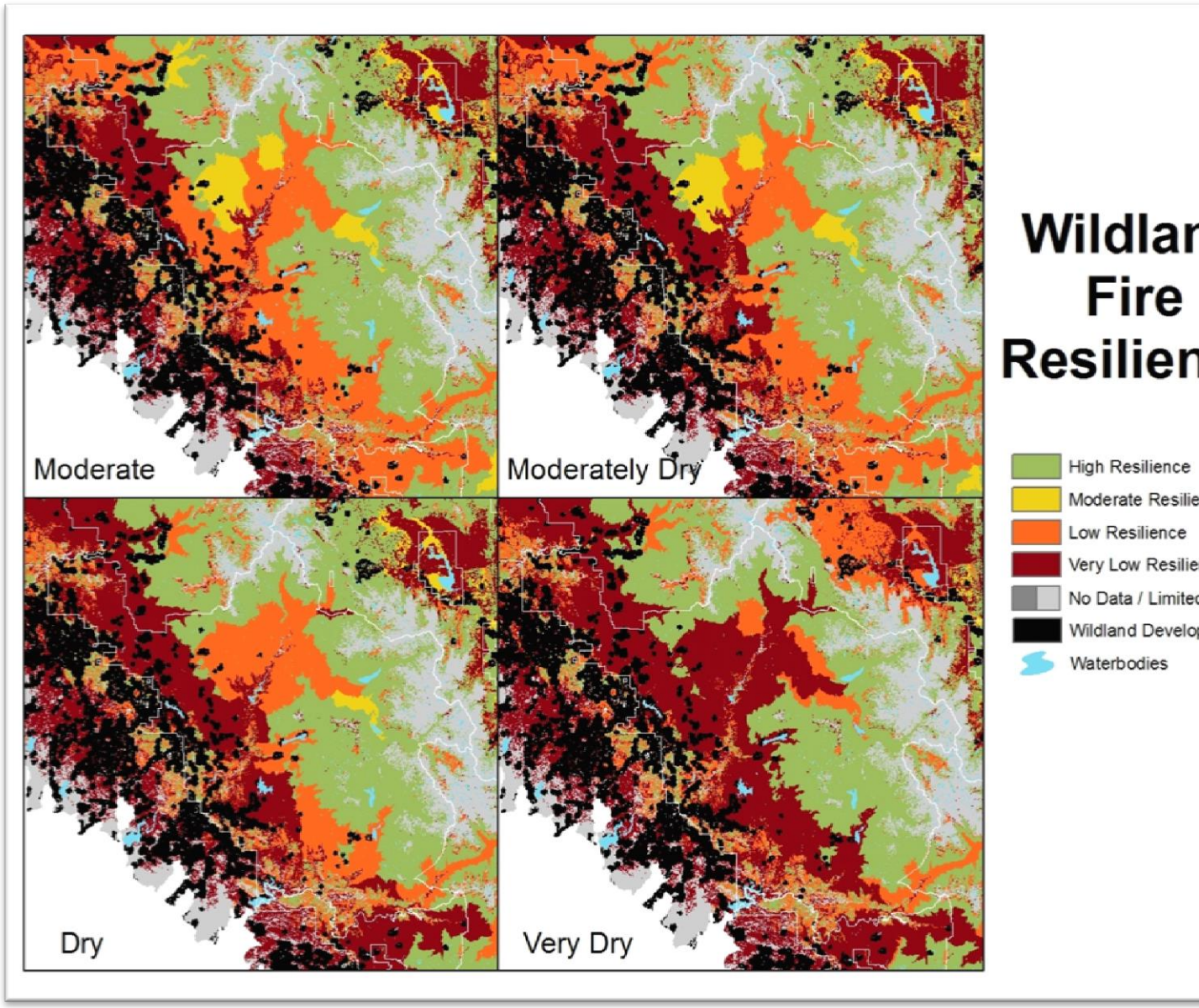
For more detailed information on the fire frequency departure, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 1, lines 390-392.

Total area burned annually is far below historic levels (Stephens et al. 2007, North et al. 2012). The result of these changes is denser, more uniform forests and shrubfields (Collins and Skinner 2013). This in turn has led to more uniform, high severity fires (van Wagtendonk and Fites-Kaufman 2006, Miller et al. 2009, Collins and Stephens 2010, Miller and Safford 2012).

A bio-regional analysis of the resilience of vegetation to fire in different weather conditions was conducted (Fites-Kaufman et al. 2013). Resiliency reflects the potential fire behavior and effects to vegetation. This is one way to measure the relative "stress level" of changes in fire.

Potential fire resiliency for four different weather scenarios is shown on the map below. The model parameters, including weather, are described in Fites-Kaufman et al. (2013). The assessment did not include changing weather conditions with terrain or daily fluctuations. That would have resulted in more variable fire effects and increased the uncertainty of the results. The purpose of this fire resilience assessment was to gain a relative understanding of the potential effects across a range of typical fire season conditions.

The map below shows the results of the fire resilience assessment. It is of four "tiled" maps, each depicting different weather scenarios. There are six categories of resilience mapped: gray is sparsely vegetated or unknown areas thought to have little or no fire potential; light green denotes high fire resilience; yellow is moderate fire resilience; orange is low resilience; and red is very low resilience. The black dots on the map represent developed areas, an indicator of wildland urban interface. In all weather conditions, highest elevations in the subalpine zone covering about one-fourth of the forest has high resilience. Below that in elevation is the upper montane, or dominantly red fir forests. Depending on the weather scenario, resilience in this zone varies from low to moderate. The top left map depicts results in moderate fire weather. These would be typical early summer fire conditions. Here most of the upper montane zone is orange and yellow, which is low and moderate resilience. In contrast, the low and mid-elevation mixed conifer, pine, and foothill areas are mostly low to very low resilience under all weather conditions. Under hotter, drier and windier conditions (high and very high weather in the lower maps), all but the highest elevations have low to very low resilience to fire. This means that most of the landscape could burn at high intensities with high severity effects. For forests, a high level of tree mortality would likely. For shrublands, a high level of above ground consumption of foliage and branches would likely occur. Areas that are depicted as moderate to high resilience would likely burn with more of a mosaic of intensities and effects.



Wildland fire resilience

Along with changes in vegetation and fire suppression, human populations have increased and impacted fire suppression and restoration. In the fire resilience maps above, the black areas show human development, towns and infrastructure. Together, these are indicators of the wildland urban interface (WUI). Development is concentrated along the western edge at lower elevations. There are some recreation developments at mid-elevations such as around Shaver Lake.

The combination of accumulated vegetation and fuels in the wildlands with increased population is contributes to increasing threats to communities, as well as increased fire management costs throughout the western United States (California Forest and Range Assessment 2010, Toman et al. 2012, Wildland Fire Leadership Council Cohesive Strategy 2013, Ecological Restoration Institute 2013). The extensive WUI in the bio-region has resulted in changes to fire management, including choice of strategies and expenditures during uncontrolled wildires (Calkin et al. 2005, Canton-Thomson et al. 2008). Extensive research has shown that fuels in the "home ignition zone" and ignitability of building materials are most critical to whether or not structures burn in the WUI (Cohen 2001, 2003, 2004, Reinhardt et al. 2008). Investigations of recent catastrophic fires in the WUI, where many structures burned, show that most of the damage occurs during the most severe fire weather conditions (Menakis et al. 2003). Fires under these conditions have rapid growth rates and/or high intensities (Reinhardt et al. 2008). A recent example in the bio-region is the Angora Fire in South Lake Tahoe in 2007 (Safford et al. 2009). Despite fuel hazard reduction treatments in the WUI, 254 homes were destroyed (Safford et al. 2009). Similar outcomes would be expected with fires on the Sierra NF. In a national risk assessment, the Sierra Nevada mountain range was identified as one of the highest risk areas in the country (Wildland Fire Leadership Council Cohesive Strategy2013). A more refined risk assessment is under development for the Sierra NF, and will be used during forest plan revision.

These types of fires put more firefighters at risk (Stockmann et al. 2010). In 2006, five firefighters were killed protecting WUI structures (Stockmann et al. 2010). In 2003, fifteen people, including one firefighter, were killed in association with the Cedar fire. Tragically, this year 19 firefighters were killed while suppressing a fire in Arizona. As a result of these newer findings, the new Cohesive Fire Strategy emphasizes: fire adapted communities, fire resilient wildlands, and risk-based fire management.

Predictions indicate climate will continue to change and magnify the fire risk to communities, as well as increase the likelihood of more intense and faster growing fires in the wildlands (McKenzie et al. 2004, Westerling et al. 2006, Westerling and Bryant 2008, Westerling et al. 2011). Longer fire seasons and drier and hotter fire conditions have already been noted over the last decade (Safford et al. 2012).

Fires do not recognize land ownership boundaries. The Cohesive Fire Strategy (2013) recognizes the importance of cooperative relationships among land managers and owners in addressing fire issues. On the Sierra NF, there is good cooperation and initiative for self-responsibility among different groups and communities. There are three Fire Safe Councils: Highway 168, Eastern Madera and Mariposa. Cooperative relationships exist with CalFire, the Mariposa County Fire Department, Huntington Lake Fire Department, Yosemite and Sequoia-Kings National Park, the Fish and Wildlife Service-San Luis Refuge, the California Department of Fish and Wildlife, the Army Corps of Engineers, the Bureau of Reclamation, the Bureau of Land Management and the Bureau of Indian Affairs.

A more detailed assessment of current conditions in the WUI is not possible at this time because there is no single database of fire hazard and community protection treatment projects or conditions.

Insects and Pathogens

Many forested ecosystems in the Sierra Nevada, from the foothills to the highest elevations, show serious symptoms of forest health stress. In many areas, past management activities have resulted in overly dense stands, imbalances in diversity of age class, and altered mixes of vegetation. This alteration from historical conditions has resulted in increased susceptibility to insects, pathogens, and weather-induced stresses. Ecosystems which are currently outside their natural range of variability are less resilient to diseases and attack by insects. Changing climates could also alter insect and pathogen lifecycle development and behavior. Bark and engraver beetles, defoliators, root diseases, mistletoes, and the introduced fungus which causes white pine blister rust are important forest insects and diseases throughout the Sierra Nevada Range. With the exception of a few introduced insects and pathogens, forests in the Sierra Nevada have the same insect and disease associates they had 100 years ago. The difference is the scale of interaction between insects, pathogens, and their hosts, in both space and time. Although large insect outbreaks are known to have occurred historically, the landscape patterns of vegetation often resulted in disturbances that were brief and confined in patches rather than over large extents.

Historically, the most significant widespread effect on vegetation has been conifer mortality associated with bark beetles, severe moisture stress, and fire. The highest numbers of acres with mortality have been attributed to bark beetles. Conifer mortality associated with insects tends to increase whenever annual precipitation is considerably less than historical average (drought). Trees that are stressed by inadequate moisture levels have weakened defense systems, leaving them highly susceptible to attack by bark beetles. The potential for disease infection and infection intensity increases when trees become more stressed. High levels of conifer mortality have been recorded numerous times in association with extreme or protracted droughts in the Sierra Nevada Range (California Forest Pest Condition Reports 1960-present). Bark beetles and other insects and diseases attack stressed and weakened trees, leading to lag times in tree mortality and an expansion of the area of tree mortality after the initial attack.

Vegetation Succession, Land Use and Management

Trees, grasses and shrubs grow and change over time. This is called vegetation “succession”. Historically, fire played an important role in shaping vegetation succession. It kept vegetation density low, more variable and favored dominance by fire-resilient species, such as ponderosa pine and black oak. Native Americans used fire to benefit food sources and life necessities such as basketry materials. This interaction changed dramatically with European settlement.

Vegetation management can be considered both a driver and stressor to ecosystems. Changes in land use have shifted over time from early settlement activities, fire suppression and timber harvest in the early and mid-part of the 20th century. Increasingly over the last 30 years more emphasis has been placed on protecting wildlife habitat and other land uses such as recreation. All of these changes have affected vegetation succession. Current levels of vegetation restoration are very low compared to rates of vegetation growth. This has resulted in denser vegetation that is more susceptible to drought, large high intensity fire, and insect and pathogen outbreaks.

Native American Management

Native Americans used fire to manage for varied beneficial uses for thousands of years. In addition to ignitions by lightning, Native Americans used fire to manage for food, basketry, hunting, travel ways, and

to reduce fire hazard (Anderson and Moratto 1996, Anderson 2006, Lake and Long 2013). Some areas were burned every year or every few years, where particularly important food sources were present (Anderson 2006). This included areas around and in meadows and riparian areas. Importantly, Native Americans did not suppress fires or if they did, not on a widespread basis. There are growing efforts by Native American tribes in and near the Sierra NF to restore fire for cultural and ecosystem benefits. For more information, see Chapter 12 of this assessment.

European Settlement

European settlement in the bio-region greatly intensified with discovery of gold in the Sierra Nevada in 1848 (Beesley 1996). Along with mining came intensive logging to fuel steam-generated equipment, and to build housing. There was also extensive grazing by livestock. Early logging focused on large diameter trees. Logging on the Sierra NF was primarily within the lower and mid-slope areas (3,000 to 7,000 feet), and typically consisted of removing many of the largest overstory trees. This was particularly significant in what is now the Bass Lake Ranger District, as a result of extensive railroad logging between the late 1880s through the 1930s. These actions resulted in substantial reductions of sugar, ponderosa and Jeffery pine forests.

Sheepherders burned extensively at high elevations in the fall on their way down from the mountains, presumably to improve forage (Sudworth 1900, Leiburg 1902, Vankat 1970, McKelvey and Johnston 1992). Some of the large shrubfields at higher elevations are attributed to this burning (Sudworth 1900, Leiburg 1902), and persist today (Nagel and Taylor 2005). Ranchers in the foothills reportedly used fires to increase forage production and enhance livestock access (Merriam 2013). Miners and other early settlers caused accidental fires.

For more detailed information see the Natural Range of Variability Assessments (Safford 2013, Estes 2013, Meyer 2013a and 2013b, Merriam 2013).

Management from the 1930s to 1980s

Starting in the early 1900s, fires were actively suppressed with the intention of "protecting forests". Logging in the mid-1900s focused on selective harvest of larger trees, and on regeneration of harvested areas in the 1980s (Verner et al. 1992, Helms and Tappeiner 1996).

Over the last century, with good intent but unforeseen consequences, most fires were rigorously suppressed. For at least half a century, this suppression was successful (McKelvey et al. 1996, Husari and McKelvey 1996, Husari et al. 2006). This fire suppression has resulted in increased vegetation density and uniformity, an increase of less fire tolerant trees, and understory fuel loads resulting in increased fire potential (van Wagtendonk 1985, Stephens and Moghaddas 2005, Stephens 2005, van Wagtendonk and Fites-Kaufman 2006, North et al. 2009).

Current Management

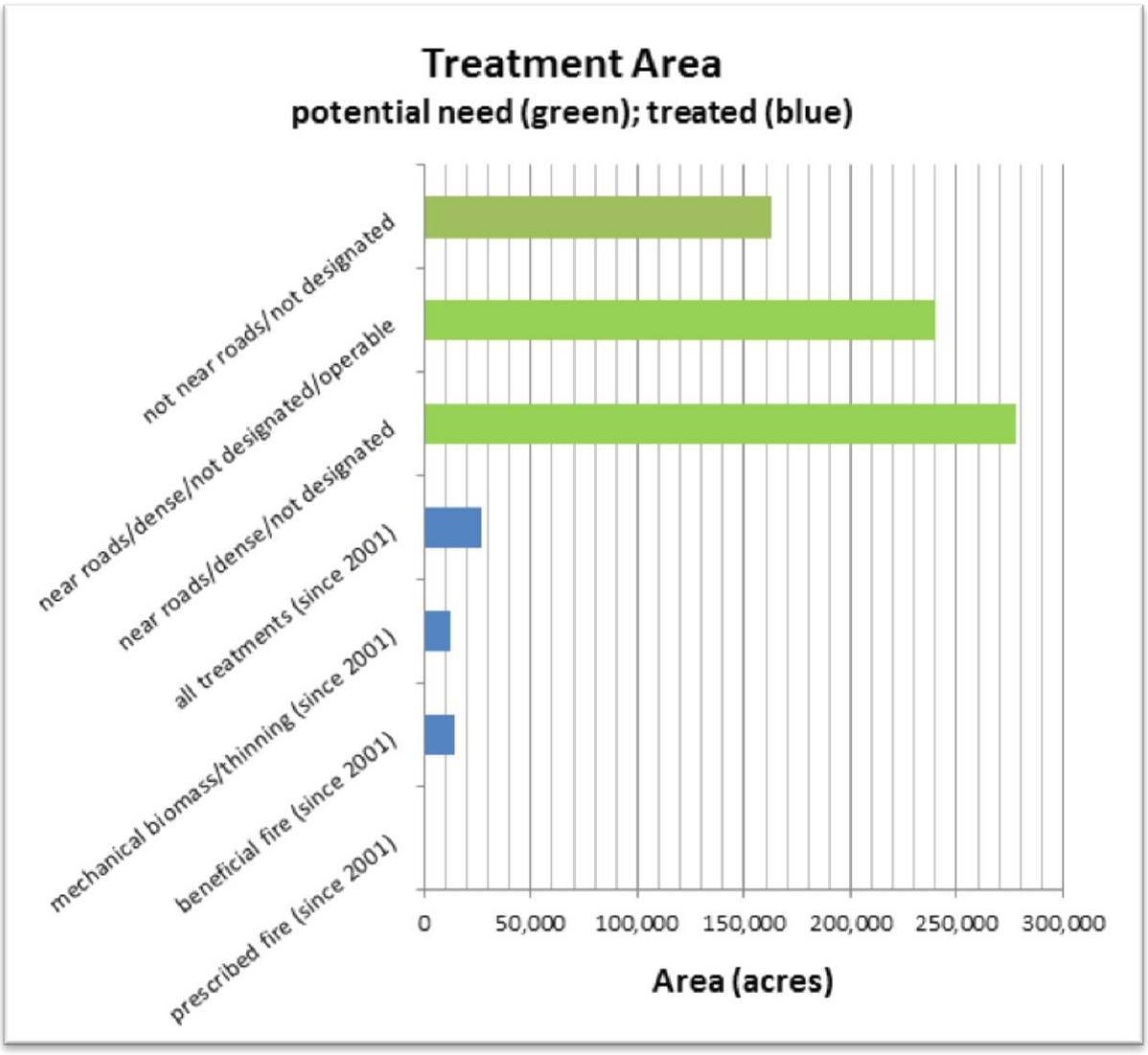
In the early 1990s, concern for the California spotted owl and other ecosystem impacts generated substantial changes in land use on federally managed lands. Harvest of large trees was essentially eliminated, and the emphasis shifted to medium and now small diameter trees. Vegetation management around nests or den sites for the California spotted owl, goshawk, fisher, and marten was heavily restricted. At the same time, a growing concern for the cumulative effects of past management and fire

suppression increased the focus on restoring fire and reducing forest densities and surface fuel accumulations.

The effects of fire suppression on increasing fuels in the Sierra Nevada (van Wagtendonk 1985, Stephens and Moghaddas 2005, Stephens 2005, van Wagtendonk and Fites-Kaufman 2006, North et al. 2009, Vaillant et al. 2013) and elsewhere in the western United States has been well documented (Reinhardt et al. 2008) and has been considered in past forest plans and forest plan revisions (USDA 2001 and 2004b). More recently, changes in climate have been overlaid on increased fuel conditions, contributing to undesirable fire effects to ecosystems and communities. An estimate of the area under different "condition classes" was developed by the Forest Service in 2008. Condition Classes 2 and 3 represent areas where vegetation density and fuels are substantially greater than historic conditions. Only 10 percent of the Sierra NF was estimated to be in Condition Class 1. A little over 20 percent was in Condition Class 3, the worst condition possible. The remainder was in Condition Class 2. The areas in the best condition are in the subalpine zone and the areas in the worst condition are in the mixed conifer and pine forests.

Currently, most of the landscape is not resilient to large, high intensity fire, and is susceptible to drought and insect/pathogen outbreaks. Restoration is proceeding at a pace and scale that is inadequate to address the problem in a timely way. The limited pace and scale of restoration and lack of active management is a stressor.

The chart below compares acres treated for restoration (thinning, biomass, or fire) since 2001 with areas potentially available for restoration. The x-axis shows acres ranging from 0 to 300,000. The y-axis shows categories which include: potential areas to treat that are not near roads or are not designated for special management; near roads/dense forest (>60 percent cover)/not designated or slopes less than 40 percent (considered operable by ground equipment); and near roads or dense forest or not designated. The acres of each are shown by the horizontal bars and are approximately 160, 240, and 279 thousand acres (respectively. There are many areas that need treatment. The size of the area treated since 2001 is slightly less than 40,000 acres. Half of that was biomass or thinning by prescribed fire or wildfires managed for resource objectives, and half was fire. These are shown with the blue horizontal bars.



Acres treated for restoration since 2001 with areas potentially available for restoration

There are multiple and complex reasons behind the limited restoration. These include smoke management regulations, limited budgets, environmental concerns, and the economics of mechanical treatments.

More detailed information on restoration activities by type on the Sierra NF can be found in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 3, lines 25-29, and Chapter 8, lines 136-145.

Illegal Land Uses

Recent research (Gabriel et al. 2012) has shown that rodenticide poisons, such as those distributed through illegal marijuana growing operations, can have detrimental impacts on species such as mice, rats and squirrels. This in turn can detrimentally influence the wellbeing of hunted and non-hunted wildlife populations, as well as have potentially negative effects on people who consume those species. This is a particular concern for fisher, a candidate species for listing under the Endangered Species Act.

Invasive Species

The influx of non-native species of animals and plants since the first Europeans arrived in California has changed the ecosystems of the Sierra Nevada. This continues to be a major and increasingly important stressor on the Sierra NF. Invasive species includes all life forms including plants, animals, invertebrates, and fungi.

Invasive Plants

Over 1,400 vascular plant taxa have been documented to occur on the Sierra NF. Approximately 25 percent of these are not native, and about 100 are so aggressive and damaging to ecosystems that they are classified as noxious weeds or invasive non-native plants.

The foothill zone has extensive areas with non-native grasses. Non-native annual grasses were imported when Europeans arrived hundreds of years ago. These include brome, wild barley, wild oats, and annual fescues. Star thistle is also prevalent.

Non-native plants make up a smaller proportion of all species in each major vegetation zone as elevation increases. An example from adjacent Yosemite National Park is given by Botti (2001), who wrote that 23 percent of plant species were non-native in the lower elevation chaparral/oak woodland zone of Yosemite, 13 percent of species in the mixed conifer zone were non-native, 5 percent of species in the upper montane zone were non-native, and only 0.5 percent were non-native in the subalpine zone. The alpine zone had no non-native species documented. This pattern appears true for neighboring lands on the Sierra NF as well. Extensive surveys of the high elevation wilderness over the past few decades have revealed very few non-native plants in the subalpine zone, and no non-native species in the alpine zone.

Invasive Animals

The barred owl is native to the east coast of the United States and has migrated west and south. It hybridizes with the California spotted owl, jeopardizing its genetic integrity (Keane 2013). It has been observed in the northern portion of the Sierra NF. It is unknown how many barred owls there are or how fast they are progressing south.

Invasive Invertebrates and Fungi

Invasive invertebrates such as the zebra mussel are impacting aquatic ecosystems. More information on aquatic invasive species is described in Chapter 1 of this assessment. White pine blister rust has impacted white pines in the bio-region for decades. For more information on its impacts to native trees, see the discussion on Natural Range of Variability in Chapter 1 of this assessment.

Contribution the plan area makes to ecological, social or economic sustainability

In 2004, the Forest Service produced a national report on Sustainable Forests (USFS 2004a). That report included a summary of the current condition of forests, based on a variety of ecological, social and economic indicators of sustainability. In defining ecological sustainability, the following was included from Helms (1998):

> ...the capacity of forests, ranging from stands to ecoregions, to maintain their health, productivity, diversity, and overall integrity, in the long run, in the context of human activity and use.

There are two main facets to evaluating the sustainability of ecosystems: drivers and the effects of stressors are operating within the natural range of variability; and ecosystems are "resilient" to drivers and stressors. That means that they can have effects from drivers and stressors but continue to function and recover. Climate, fire, insects and pathogens, invasive species, vegetation succession, and vegetation management all occur simultaneously on the landscapes of the Sierra NF. They influence each other. Fire affects vegetation succession. Vegetation succession affects insects and pathogen levels. Climate affects fire, vegetation succession, insects and pathogens, and invasive species. When considering ecological sustainability as influenced by drivers and stressors, it is important to consider them all together.

Natural Range of Variability

Overall, ecosystems on the Sierra NF are outside of the natural range of variability in terms of fire, insect/pathogens, air quality, invasive species, and vegetation succession.

In the table below, the conditions of these drivers and stressors are summarized using similar elements as described in the National Report on Sustainable Forests (USFS 2004). The deviations from the natural range of variability are great for foothill and montane areas (mixed conifer, oak and pine), moderate for upper montane (red fir and Jeffrey pine), and low for subalpine and alpine areas for all characteristics (fire, vegetation succession, insects/pathogens, air quality). The trend is for these characteristics to continue to deviate from the natural range of variability, and to deviate more because of the low rate of restoration vegetation management. This includes fire managed for resource objectives

Conditions of drivers and stressors from the National Report on Sustainable Forests (2004)

Characteristic	Condition	Trend
Area affected by insects and pathogens beyond natural range	Mostly outside of natural range. Dense forests and climate change increase susceptibility to large outbreaks.	Continued. Restoration far below rates needed to restore. Climate change will make worse.
Area affected by air pollutants that may cause negative effects	Poor and worsening. Especially lower and mid-elevations.	Continued, although some air control measures have improved conditions some.
Area affected by invasive species	Poor in foothill zone, extensive non-native grasses. Some invasions in higher elevations.	Continued. Difficult to restore foothills. Climate change enhances invasions.
Area with fire condition class outside of natural range	Mostly outside or range (except subalpine/alpine)	Continued. Restoration far below rates needed to restore. Warming and longer fire season is making problem worse.
Area with vegetation condition outside of natural range	Mostly outside or range (except subalpine/alpine)	Continued. Restoration far below rates needed to restore. Climate change will make worse.

Resilience

Ecosystem resilience can be difficult to characterize. In essence, it is the ability of an ecosystem to absorb changes from drivers and stressors, and still maintain function (biodiversity and processes such as carbon cycling). Over thousands of years, drought has occurred in the Sierra Nevada. A severe drought has not been experienced recently on the Sierra NF or in the bio-region. However, a severe drought is inevitable and with current trends in climate, the effects are likely to magnify with longer, drier summers and lower snowpack already evident. Predicted trends are that climate will continue to change and magnify the fire risk to communities, as well as to increase the likelihood of more intense and faster growing fires in the wildlands (McKenzie et al. 2004, Westerling 2006, Westerling and Bryant 2008, Westerling et al. 2011). Longer fire seasons, and drier and hotter fire conditions have already been noted over the last decade (Safford and Meyer 2012).

Given that the current condition of vegetation is denser than the natural range of variability, it is likely that the foothill and montane landscapes on the Sierra NF will not be resilient to drought, high severity fire, and insect and pathogen outbreaks. Air pollution is currently at levels where there is impaired function. This weakens vegetation, making it more susceptible to drought and insects and pathogen related die-back. Increased tree mortality has already been reported (Van Mantgem et al. 2009). Fires are more likely to be more uniformly severe across large areas. Severe fire has always occurred. In the past, however, vegetation was more heterogeneous and as a result the fires were patchier.

In the foothills, invasive grass species have dominated large areas since European settlement. More recently, they have spread along roads, and sometimes with fires in montane chaparral and forests. Invasive species may be enhanced by climate change. These invasive grasses also change the fire regime. In chaparral, invasive annual grasses shift the fire regime to a more frequent one.

Overall, the foothill and montane landscapes have low resilience. The upper montane landscapes have moderate resilience. Subalpine and alpine ecosystems have high resilience, although they may be particularly vulnerable to warming climate and reduced snowpack.

Information gaps

An assessment of current conditions in the wildland urban interface is not possible at this time because there is no single database of fire hazard and community protection treatment projects or conditions.

Chapter 4: Carbon

Forests play an essential role in global carbon storage, by removing carbon dioxide (CO_2) from the atmosphere and by storing carbon as biomass within ecosystems. Increases in atmospheric CO_2 over the last century have been linked to rising temperatures, and because forests absorb CO_2, they play an important role in regulating climate. In turn, changes in climate, including precipitation and temperature, influence the rates of carbon uptake and loss from an ecosystem. As a result, it has become increasingly important to understand the feedback mechanisms between carbon uptake in forests and climate to ensure the maintenance of healthy and productive ecosystems.

Carbon stock is a term used here to describe the total pool of carbon in an area, including live and dead biomass, and above and below ground carbon. Atmospheric CO_2 is specifically addressed in Chapter 2 of this assessment, and is considered here only as it is linked to forest carbon stocks. Other issues that influence carbon stocks, including the harvest of wood products, fire, disease, and climate, are covered in more detail in other chapters of this assessment. In this chapter, the focus is on assessing the issues that associate carbon stocks with climate change.

Important Information Evaluated in this Phase

One of the goals of the 2010-2015 USDA Strategic Plan is to ensure national forests and private working lands are conserved, restored, and made resilient to climate change (USDA 2010). The Forest Service roadmap for responding to climate change identifies the assessment and management of carbon stocks as a major element of its plan.

The 2006 Global Warming Solutions Act (CA Assembly Bill AB 32) requires California to reduce greenhouse gas emissions to 1990 levels by 2020, and to identify the most feasible and cost-effective methods to reduce emissions. Reductions may be achieved through a variety of methods, including capping greenhouse emitting sectors (manufacturing, energy production, transportation) and issuing emissions allowances that will achieve these greenhouse gas reductions. Because California forests were identified as a carbon sink, an annual sequestration target of 5.2 Tg (teragrams) of carbon per year through 2020 was identified for the forest sector. This is to be achieved through sustainable management practices, including reducing the risk of catastrophic wildfire, and the avoidance or mitigation of land use changes that reduce carbon storage. Though non-binding, the plan states that, “The federal government must also use its regulatory authority to, at a minimum maintain current carbon sequestration levels for land under its jurisdiction in California”.

As a result, the Forest Service evaluates current and potential net annual loss or gain in the assessment area’s carbon storage, which determines whether the area is a source or sink for carbon. The feedback mechanisms between carbon storage and long term site productivity in the assessment area are also

assessed. Carbon stocks and accounting can be performed in multiple ways. The United States adopted standard accounting and reporting protocols for forests and forest products, adapted from the U.S. Department of Energy (DOE) 1605(b) methodology -Technical Guidelines for Voluntary Reporting of Greenhouse Gas Program, Chapter 1. These forest carbon estimates included live trees, understory vegetation, standing dead trees, forest floor, down dead wood, soil carbon, harvested wood in use, and landfilled wood products (EPA 2004).

For more detail on the information evaluated, see the July 3, 2013 snapshot of the Bio-Regional Living Assessment Chapter 4, lines 40-121.

Nature, Extent and Role of Existing Conditions and Future Trends

A comprehensive review of the carbon cycle can be found in Janzen (2004). Basically, CO_2 in the atmosphere is absorbed by vegetation, which converts CO_2 to biomass in the process of photosynthesis. The carbon present in biomass, including leaves, stems, and roots, is converted to litter and dead wood. Carbon dioxide is emitted back into the atmosphere by plants and animals during respiration, and is released from microbes that decompose litter and dead wood. Carbon can also be removed from an ecosystem by wood harvesting, grazing, fire, transport of soil and litter in streams or floods, and by the transport of soluble carbon molecules in soil.

The term “carbon sequestration” as used here refers to the process of carbon uptake and storage that is carried out primarily by vegetation. This forest vegetation includes carbon estimates for live trees, understory vegetation, standing dead trees, forest floor, down dead wood, soil carbon, harvested wood in use, and landfilled wood products (EPA 2004).

Estimates have been calculated for the carbon sequestered in the forestlands of the Sierra NF. Forestlands are defined here as at least 10 percent cover by live trees of any size, including land that formerly had such tree cover and that will naturally or artificially be regenerated (Smith et al. 2004). A nationwide study of estimates of forestland live tree, understory vegetation, standing dead tree, forest floor, down dead wood, and soil carbon stocks was conducted by Heath et al. (2011), using ground-based datasets from the Forest Service Forest Inventory and Analysis program, that summarized data by region and forest. These estimates are broad scale approximations of carbon stocks that did not include harvested wood in use, or landfilled wood products.

The table below shows forestland carbon stocks within the assessment area. Forest carbon density is generally greatest in the central sub-region of the assessment area, and lowest in the eastern sub-region. This can be generally attributed to climatic patterns that affect ecosystem productivity, and in turn carbon storage. The Sierra NF has the third highest forest carbon density in the bio-region after the Eldorado and the Plumas National Forests.

Forestland carbon stocks within the assessment area

Subregion	National Forest	Forest carbon density(Mg C/ha)	Forest area (1000 ha)	Total forest C +/- 95 percent CI as percentage of mean (Tg)	Above ground live tree C density(Mg C/ha)
Central	Eldorado	281.9	232	65+/-20	135.4
South, East	Inyo	138.9	456	63+/-15	52.6
South, East	LTBMU	200.5	75	15+/-49	86
North, East	Modoc	142.9	517	74+/-15	38.8
North	Plumas	252.2	454	114+/-13	116.5
South	Sequoia	203.6	393	80+/-17	88.6
Central	Sierra	244.3	455	111+/-14	115.5
South	Stanislaus	235.3	320	75+/-18	106.5
Central	Tahoe	242.1	327	79+/-17	111.1
North	Lassen	213.9	420	90+/-15	91.2

Other important landscapes contributing to carbon sequestration are shrublands and meadows. There are no specific Sierra NF estimates for carbon in these landscapes but studies have shown that these are important areas for sequestration. Meyer (2012) summarized findings regarding carbon storage in cold desert shrublands. The deep rooting systems and high root-to-shoot ratios of these ecosystems results in large carbon reserves, despite the fact that productivity in these areas is low compared to most forested lands, and that their role in the carbon cycle is assumed to be minor. Soil carbon dominates the terrestrial carbon pool, exceeding carbon stocks held in plant biomass nearly five-fold (Janzen 2004). Similar to shrublands, meadows may play a significant role in the carbon cycle, primarily due to their extensive below ground biomass. In addition, the role of meadows in the carbon cycle is magnified because meadows are typically associated with greater soil moisture compared to surrounding landscapes, and soil moisture is correlated to greater ecosystem productivity and respiration (Norton et al. 2006).

There are some key factors influencing carbon sequestration in the forest. Climate change that affects the growth of vegetation will impact the amount of carbon stored in the forest. Much of the carbon now accumulating in these forests is being added in the form of ladder fuels, which carry fire from the lower vegetation canopy to the upper canopy of trees. As mean fire size and burn severity has increased with vegetation changes, fire has come to play an increasingly important role in carbon storage (Hurteau and North 2010, North 2013). Grazing also influences the carbon storage of ecosystems through forage removal, hoof action and activity that affects soil and livestock waste. Vegetation management for fuels treatments can reduce fire severity and consequent carbon release, but also reduce forest carbon stores in the short term (North 2013). Insect and disease outbreaks can convert forests from carbon sinks to sources (Kurz et al. 2008, Pfeifer et al. 2011). Finally, predicted increases in the population of California will have an influence on carbon storage and sequestration in the assessment area. The primary impact will be through continued carbon emissions and subsequent rising temperatures, which may reduce the long term capacity of terrestrial ecosystems to act as carbon sinks.

Looking at trends in carbon sequestration, a Forest Service study conducted an assessment of carbon sequestration capabilities of the national forests in California over the next 100 years (USFS 2009). The

assessment analyzed forest growth, disturbance, and management options under a range of management scenarios for the national forests in California. The analysis concluded that under then current (2009) forest management activities, over the next four to six decades, California's national forests will accumulate carbon at a higher rate than carbon will be lost. This will be at a decreasing rate because of increased carbon loss through disturbances such as wildfire, insect and disease related pest mortality and inter-tree competition. However, at some point in the mid-21st century, carbon losses from wildfire, disease and other disturbances will exceed sequestration, and national forests in California will become net emitters of carbon.

For more detailed information on condition and trend in the bio-region, see the July 3, 2013 snapshot of the Bio-Regional Living Assessment Chapter 4, lines 122-479.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The forests of the bio-region will play an important role in helping California meet its greenhouse gas emission reduction goals. Currently, these forests store a large quantity of carbon in living biomass, standing and downed woody debris, litter and soil organic carbon. Markets for carbon do exist and therefore a price for carbon has been established and can be used to value this sequestration. A central element of California's Global Warming Solutions Act (AB 32) is a cap-and trade program now underway, which allows the state to distribute carbon allowances as tradable permits (CARB 2013).

Forest management can affect the value of carbon sequestration by controlling stand structure, composition and growth rates, as well as by influencing the frequency, size and severity of natural disturbances that would reduce current inventories. A recent study determined that this value to people of carbon sequestration is largely dependent the frequency and extent of wildfires in the bio-region. As a result, without an increase in the pace and scale of ecological restoration, it was estimated that the forests of the bio-region will become net emitters of carbon sometime around the middle of the 21st century. Therefore, increased pace and scale of restoration to reduce fire disturbances will be critical in maintaining the long term value of carbon sequestration (USDA Forest Service 2009).

In addition, restoration can contribute to economic and social well-being by providing opportunities for wood product activities. According to the Intergovernmental Panel on Climate Change (IPCC) "When used to displace fossil fuels, wood fuels can provide sustained carbon benefits, and constitute a large mitigation option" (Nabuurs et al. 2007 p.551). A recent study estimates that forests in the United States are capable of sustainably producing 368 million dry tons of wood per year, with 41 million dry tons from currently unused logging residues and 60 million dry tons from hazardous fuel treatments (Perlack et al. 2005). If applied to bioenergy production, this wood residue could offset a substantial percentage of the country's CO_2 emissions from fossil fuels (Richter et al. 2009).

In addition to ongoing energy production from milling byproducts at area wood processing facilities, several opportunities exist to use wood residues from timber harvest, hazardous fuel reduction projects, and other silvicultural treatments in the assessment area. These opportunities include an extensive network of bioenergy facilities, potential to develop a network of small bioenergy systems under California Senate Bill 1122, as well as a strong push by the biomass industry to develop strategically located wood heating systems to offset propane, diesel and electric systems. There is potential for a substantial increase in wood energy production in the assessment area that could replace CO_2 emissions

from fossil fuels, while also reducing CO_2 emissions from pile burning and other forest residue treatments.

For more detailed information on carbon and its contribution to sustainability in the bio-region, see the snapshot of the Bio-Regional Living Assessment Chapter 4, lines 480-526.

Information Gaps

Long term projections of regional net carbon balances depend on assumptions about the future vegetation composition of currently forested areas under changing climate conditions (Canadell et al. 2007, Kashian et al. 2006). Some models suggest that changes in climatically suitable habitat, combined with amplified disturbance regimes may result in some forests of the bio-region converting to non-forest vegetation with associated losses in carbon stocks (Westerling et al. 2012). However, there is considerable uncertainty regarding the effects of climate change on the composition of forest vegetation. These uncertainties in future forest composition and structure contribute to the uncertainty in long term projections of forest carbon stocks and flux, and regional net carbon balances (Smithwick et al. 2008, Rhemtulla et al. 2009)

Chapter 5: At-Risk Species

At-risk species are defined as the federally recognized threatened, endangered, proposed, and candidate species and potential species of conservation concern known to occur within the plan area. The list of at-risk species is identified by the regional forester in coordination with the forest supervisor and the list is purposefully called a potential list because the current list will be refined, particularly for invertebrates and plants, before completing the final Sierra NF assessment and it may further be refined during the planning process prior to approval of the plan. These species are identified to help the forest plan adopt appropriate components for a complementary ecosystem and species-specific approach to maintaining the diversity of plant and animal communities and the persistence of native species in the plan area (36 CFR 219.9).

The 2012 Planning Rule draft directives requires that the assessment to evaluate the status within the plan area of at-risk species considering the current plan direction, the available information, and the status of ecosystem integrity. The draft directives provide specific criteria for identifying species to be considered at-risk.

Important Information Evaluated in This Phase

Detailed information regarding species life history, distribution, status, stressors, drivers and threats, and trends is summarized for this assessment in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 5. For some species, additional species status and life history information was provided by Forest Service biologists and botanists that was not included in the July 2, 2013 snapshot. Additionally, some information was gathered from original literature, mostly government documents related to the listing process for federally listed species. These summaries are not intended to be thoroughly complete regarding a species life history, but rather they provided an overview sufficient to inform this assessment and discuss known status and trends for the species.

Similarly, this assessment will not repeat general life history information, but will briefly describe three key factors for each species:

- species status on the Sierra NF

- key ecological conditions needed to support the species
- key risk factors that affect the species

This information may later inform the development of plan components. The full suite of readily available information relevant to at-risk species will be considered when developing and evaluating plan components throughout plan revision. For considering conditions and trends related to habitats and ecological conditions important for a species, other chapters of this assessment are also considered, especially Chapters 1, 2 and 3. Conditions and trends for human-related stressors such as habitat fragmentation from encroachment and development, and disturbance from recreation and other uses of the forest are described in more detail in Chapters 6, 7, and 9.

Nature, Extent and Role of Existing Conditions and Future Trends

Federally recognized species under the Endangered Species Act and species of conservation concern are two distinct components of at-risk species. They each play a different role in informing the development of plan components. National forests are managed to contribute to the recovery of federally listed species and to not jeopardize listed species or their habitats. Plan components are developed to provide the ecological conditions necessary to maintain a viable population of Species of Conservation Concern within the plan area.

Federally Recognized Species

On the Sierra NF, there are 12 species federally recognized as threatened, endangered, proposed, and candidate species. They are separated into the following life form groups: fish, amphibians and reptiles; birds and mammals; invertebrates; and plants.

Fish, Amphibians and Reptiles

Federally listed fish, amphibians and reptiles

Common Name	Scientific Name	Status
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	Threatened
Paiute cutthroat trout	*Oncorhynchus clarki seleniris*	Threatened
Yosemite toad	*Anaxyrus canorus*	Proposed
Sierra Nevada yellow-legged frog	*Rana sierriea*	Proposed
California red-legged frog	*Rana aurora draytonii*	Threatened

Lahontan cutthroat trout

Species Status on the Sierra NF

This species evolved during a wetter period in the Late Pleistocene when much of the western Great Basin was inundated, forming larger lake and river systems, including its namesake Lake Lahontan that covered much of northwest Nevada and parts of Oregon and California (USDI - USFWS 1995). Today across its range, it is found in less than 1 percent of the historic lake or reservoirs and only about 10 percent of the stream habitats that it occupied prior to 1844 (USDI - USFWS 1995).

On the Sierra NF, two populations of pure Lahontan cutthroat trout inhabit approximately 1.5 miles in W. Fork of Portuguese Creek (Madera County) and one of its tributaries, and two miles along West Fork Cow Creek (Fresno County) (USDI-USFWS 1995 with mapping corrections by USFS). Annual population monitoring occurs for this species. The population in Portuguese Creek appears to be stable, while the population in Cow Creek appears to be declining (USDI-USFWS 1995). Both of these populations are actually outside of the species historic, native range and are a result of historic transplanting of fish from about 1897 (USDI-USFWS 1994). As pure genetic stock, these populations are important sources for other reintroductions within the historic range.

Habitat for Lahontan cutthroat trout on the forest has been mapped and is considered as 200 feet on either side of Class 1, 2 and 3 streams in the West Fork Portuguese and Cow Creek Critical Aquatic Refuges (USDA-USFS 2001, Volume 4, Appendix I, pp. I-58).

Key Ecological Conditions Needed to Support the Species

Isolation. Lahontan cutthroat trout do not compete well with other trout species and rarely co-exist when non-native trout are introduced. In some locations, they can hybridize with non-native rainbow trout (Behnke 1979). Currently, physical barriers limit upstream movement of non-native rainbow trout for both populations and brook trout are not a threat.

Cold water. Lahontan cutthroat trout require water temperatures less than approximately 55 degrees Fahrenheit during the spring and summer egg incubation period (USDI - USFWS 1995). Adults can withstand greater fluctuations in temperature, and do best in water temperatures that are less than 68 to 72 degrees Fahrenheit.

Key Risk Factors

Non-native trout. The illegal movement of rainbow trout or brook trout could diminish the genetic integrity of these pure genetic stocks and lower their value as a source for reintroductions.

Paiute cutthroat trout

Species Status on the Sierra NF

Paiute cutthroat trout are a subspecies that evolved from Lahontan cutthroat in Silver King Creek in Alpine County (USDI - USFWS 1985).

The species was transplanted to Sharktooth Lake (John Muir Wilderness, Fresno County) and Stairway Creek (Ansel Adams Wilderness, Madera County) (Ryan and Nicola 1976, Mills 1977, USDI - USFWS 1985, 2004). The Paiute cutthroat trout population is estimated to be distributed over 2.3 km of Sharktooth Creek and 3.5 km of occupied habitat within Stairway Creek (USDI - USFWS 2004).

This population appears to be stable based on observations from Forest Service aquatic biologists monitoring every five years, between 1999 and 2010.

Key Ecological Conditions Needed to Support the Species

Suitable stream habitat. The Paiute cutthroat trout recovery plan identified that "adult fish prefer stream pool habitat in low gradient meadows with undercut or overhanging banks and abundant riparian vegetation" (USDI – USFWS 2004, p. iii).

Key Risk Factors

Non-native trout. This species readily hybridizes with rainbow and other cutthroat trout.

Angling. This species is extremely vulnerable to angling (Moyle 1976).

Yosemite toad

Species Status on the Sierra NF

Yosemite toad is endemic to the Sierra Nevada and its range extends from north of Ebbetts Pass (Alpine County) south to approximately the Kings River (Fresno County) (Brown et al. 2009). The elevational range is approximately 6,400 to more than 11,000 feet (Jennings and Hayes 1994). On the Sierra NF, the Yosemite toad occurs throughout its elevational range and to date, the forest has detected the species in 355 meadows.

General declines in populations over time have been well noted (see for example, Jennings and Hayes 1994, Drost and Fellers 1996, Kagarise Sherman and Morton 1993). Additional monitoring across the species range found the species still present in large portions of the area occupied from 1990-2001, but also found very low evidence of reproduction in watersheds that were historically occupied prior to 1990 (Brown et al. 2012). During the eight year monitoring period (2002-2009), occupancy appeared stable, though annual sample sizes were small (Brown).

Key Ecological Conditions Needed to Support the Species

Suitable shallow ephemeral waters. On the Sierra NF, seasonal water on flat sites at high elevation with warmer temperature and other characteristics related to temperature and precipitation are needed to support breeding (Liang 2010). Several studies have examined why annual occupancy of breeding sites varies, but definitive causes are not known (Brown et al. 2012, Liang and Stohlgren 2011).

Key Risk Factors

Mortality in adults. Population persistence may depend in part on the survival of long-lived adults who continue to breed despite years of low or no recruitment. With low populations, loss of even a few adults could threaten population persistence. Eggs and tadpoles are affected by freezing or desiccation of the shallow ephemeral water where Yosemite toads breed, thus mortality of young appears naturally high in this species and there may be little opportunity to improve survival of this life stage.

Livestock grazing. Livestock grazing can affect meadows by lowering water tables (Armour et al. 1994, Menke et al. 1996, Belsky et al. 1999, USDI - USFWS 2013), changing vegetation cover (Bull and Hayes 2000), and trampling of animals (Bartelt 1998). This is especially true with past grazing practices, which may still contribute to diminished habitat from lingering effects, but a study of recent grazing practices by the Forest Service has found no difference for many population and habitat factors for the Yosemite toad (Tate et al. 2010, Lind et al. 2011, Roche et al. 2012).

Climate change. This species has a short window of time to emerge from hibernation at snowmelt to breed before reentering hibernation in the fall (Karlstrom 1962, Kagarise Sherman and Morton 1993). In this short window of approximately four months, females must mate and lays eggs which must then hatch and the tadpoles metamorphose. The young must then find a suitable overwintering site. This species is sensitive to the timing of loss of snowpack, amount of warm summer water and timing of winter cold weather.

Meadow encroachment. Past and current suppression of wildfire may allow meadows to become encroached by conifers, reducing habitat quality. Climate change may also affect woody vegetation growth in meadows in the future but a meadow evaluation on the Sierra NF has not shown that conifer encroachment is currently a significant concern (MacDonald and Kuitu 2009 as summarized in Chapter 8 – Range in this assessment).

Sierra Nevada yellow-legged frog

Species Status on the Sierra NF

Historic accounts indicate that this species was once extremely abundant across its range with some populations in the hundreds and even thousands (Grinnell and Storer 1924, Bradford 1991, Pope 1999, Vredenburg et al. 2010). Several recent studies have shown dramatic declines in the species in both distribution and population compared to these historic levels (Bradford 1991, Drost and Fellers 1996, Bradford et al. 1994, Vredenburg et al. 2007, Brown et al. in press).

There are 48 known occupied locations on the Sierra NF. The majority of occupied sites are at high elevations within wilderness areas, although a number of sites at mid-elevations between 5,000 and 6,000 feet outside wilderness areas have been located. Some of the extant populations, particularly at lower elevations, have ecological significance because they occur in meadow and stream habitats.

Key Ecological Conditions Needed to Support the Species

Deep water in high elevation lakes and streams. Suitable habitat conditions for this species depend on sufficient perennial water to meet the needs of each life stage. Adjacent streambank and lakeshore habitats affect water attributes and must be considered for conditions and trends.

Key Risk Factors

Non-native fish. Non-native trout are known to impact populations, and experimental removal of introduced trout has resulted in rapid recovery when populations aren't also impacted by diseases (Vredenburg 2004, Knapp et al. 2007).

Climate change. This species requires deep perennial water that serves as breeding habitat and overwintering protection from lake freezing. Changes in snowpack and season and timing of rain and snow can affect both summer water depth as well as winter lake freezing. There is some uncertainty here however as they have also been found to survive in shallow lakes that freeze completely (Pope 1999, Pope and Matthews 2001, Lacan et al. 2008).

Fragmentation of populations. The majority of populations are small and isolated (Brown et al. in prep., Bradford et al. 1993, Knapp et al. 2003, CDFW 2011), increasing the risk that the loss of populations will create barriers to genetic mixing and other genetic risks inherent to small populations (USDI - USFWS 2013).

California red-legged frog

Species Status on the Sierra NF

The California red-legged frog was historically found throughout the Sierra Nevada foothills and coastal range mountains in California (USDI - USFWS 2010, Fellers 2005). It ranged in elevation from sea level to about 5,200 ft. (USDI - USFWS 2002).

No known populations historically occurred on the Sierra NF. There are three historical records of California red-legged frog in the area of the forest, west of the actual forest boundary: Willow Creek; the San Joaquin Experimental Range; and Miami Creek (Jennings et al. 1992, Hansen personal communication 1993). California red-legged frogs are considered to be extirpated from areas adjacent to the Sierra NF, probably since the late 1960s according to herpetology expert Mark Jennings (Strand personal communication 1999). Systematic surveys have not been conducted to confirm this.

Key Ecological Conditions Needed to Support the Species

The Sierra NF is not within the historic range of the species and the forest is not identified as critical habitat for the recovery of the species but portions of the forest below 5,000 feet are considered potential habitat in the species recovery plan (USDI - USFWS 2010). However, the species is currently considered to be extirpated from the forest and adjacent areas, therefore, no key ecological conditions on the forest are identified as needed to support the species.

Key Risk Factors

Non-native species. The introduction and existence of non-native species such as bullfrog, non-native trout, and other non-native fish species can reduce or limit populations (USDI - USFWS 1996). Given

the distance of the Sierra NF to known populations, it is unlikely that this risk factor on National Forest System (NFS) lands is a substantial direct risk to existing populations off the national forest.

Birds and Mammals

Federally listed birds and mammals

Common Name	Scientific Name	Status
Sierra Nevada bighorn sheep	Ovis canadensis sierra	Endangered
California condor	Gymnogyps californianus	Endangered
Fisher	Martes pennant	Candidate

Sierra Nevada bighorn sheep

Species Status on the Sierra NF

The historical range of the California bighorn sheep includes the eastern slope of the Sierra Nevada, as well as the higher elevations on the western slope from Sonora Pass in Mono County south to Walker Pass in Kern County, a total distance of about 215 miles (Wehausen 1979, 1980).

The historic range in the Sierra NF generally was summer ranges on the Sierra Nevada Range crest and upper western slopes of that crest. These animals were believed to be from winter range sheep herds moving from the eastern flanks of the Sierra Nevada. The herds using the Sierra NF include a few animals from the Convict Creek area and 5-10 animals from the Wheeler Ridge area. Both of these populations use high elevations in the Sierra Nevada crest during the spring through fall and migrate east onto the Inyo NF during the winter (Stephenson personal communication 2013).

Approximately 40,000 acres of critical habitat are designated on the Sierra NF with two critical habitat units, Convict Creek and Wheeler Ridge that overlap portions of the forest near the Sierra Nevada crest (USDI - USFWS 2008).

Overall, since federal listing, the species has increased in number and range in the southern Sierra Nevada (Stephenson personal communication 2013).

Key Ecological Conditions Needed to Support the Species

Suitable open habitat. Bighorn sheep select open habitats that allow detection of predators at sufficient distances for adequate lead-time to reach the safety of steep, generally rocky slopes (USDI - USFWS 2007). Conifer encroachment, especially an increase in pinyon and juniper, facilitated by fire suppression may reduce habitat quality by increasing predator hiding cover.

Key Risk Factors

Disease transmission from domestic sheep and goats. Historically, this was an issue with sheep grazing allotments mixed with some big horn habitat. The Sierra Nevada national forests no longer have permit grazing allotments in the ranges of big horn sheep.

Predation by mountain lions. High rates of predation by mountain lions have been recorded (USDI - USFWS 2007; Stephenson et al. 2012).

California condor

Species Status on the Sierra NF

The species historically occurred more widely throughout the southwest and also fed on beaches and large rivers along the Pacific coast. Around 1800, California condors inhabited all of California and most western states (Snyder and Synder 2005). The recent range is restricted to chaparral, coniferous forests, and oak savannah habitats in southern and central California and includes the west slope of the Sierra Nevada as far north as the southern portion of Fresno County (USDI - USFWS 1976).

During recent years condors also have been documented flying over the southern portion of the Sierra NF in southern Fresno County. However, there are no reports of feeding, perching or nesting in the forest (USDI-USFWS 2012a).

Key Ecological Conditions Needed to Support the Species

Contributions to large animal prey. As no known or historic nesting sites occur on the Sierra NF, the best contribution of the forest is likely providing sources of potential prey. Natural mortality of ungulates and other large animals serve as potential sources of prey for foraging condors.

Key Risk Factors

Lead ingestion and shooting. As carrion feeders, condors are highly susceptible to lead poisoning from eating lead bullets or fragments in dead animals. Artificial feeding and careful monitoring for signs of lead poisoning are currently used in response to this risk. In addition, condors continue to be targets for illegal shooting (USDI-USFWS 2013a).

Collision with power lines. Since 1992, four condors are known to have died related to collision with powerlines, not on the Sierra NF (USDI-USFWS 2012a).

Fisher

Species Status on the Sierra NF

Grinnell et al. (1937) described the distribution of fishers in California as a continuous arc from the northern Coast Range eastward to the southern Cascades, and then south through the western slope of the Sierra Nevada, but did not attempt to estimate population numbers or population connectivity. Zielinski et al. (1995) determined that fishers remain in just two areas comprising less than half of the estimated historic distribution: northwestern California and the southern Sierra Nevada from Yosemite National Park south, separated by a distance of about 250 miles.

The southern Sierra Nevada population of fishers currently exists on the Sierra and Sequoia National Forests, the Sequoia and Kings Canyon National Parks, as well as a few individuals in Yosemite National Park south of the Merced River. Recent estimates of fisher in the southern Sierra Nevada indicate there are approximately 160–360 adults (Spencer et al. 2008). There are indications that the southern Sierra Nevada population is stable (Zielinski et al. 2013, Sweitzer personal communication 2013).

Key Ecological Conditions Needed to Support the Species

Forest overstory and understory cover. Fisher tends to avoid large open areas (Weir and Corbould 2010) and maintaining diverse understory vegetation is thought to be important to support abundant diverse prey

(Naney et al. 2012). The southern Sierra population is closely associated with dense stands of 11.4 to 24 inch diameter Sierra mixed conifer forest type (Zielinski et al. 2004). Research and planning related to the Dinkey Landscape Restoration Project has focused on designing and evaluating suitable vegetation management practices that can reduce the threat of habitat loss from uncharacteristic wildfire while retaining suitable habitat conditions. Recent research highlights the importance of fine scale and landscape scale heterogeneity and the role that understory cover plays in fisher use of den sites across their home range.

Hardwood trees for cavities and acorn mast. Large, mature hardwoods provide cavities for resting and denning, and also support abundant prey species. Areas with large hardwoods and abundant mast support smaller home ranges as animals can find sufficient food resources in a smaller area (MacFarlane 2010, Zielinski et al. 2004).

Abundant cavities in trees. Fisher appears to depend more on the availability of key forest structural elements than old forests (MacFarlane 2010, Zielinski et al. 2004). Fisher requires a relatively large number of large cavities within their home range and large cavities are typically found in older forests due to natural decay factors (Manion 1991).

Key Risk Factors

Loss of key forest structures, forest canopy, and fragmentation. Large areas of high severity fire can reduce important forest structures such as large trees with cavities and mature mast-producing hardwoods. Fisher require areas with sufficient overstory and understory cover and uncharacteristic wildfire can reduce tree cover and also fragment these area and create barriers to animals traveling across heavily burned areas. These same key habitat elements can also be affected by planned management activities.

Rodenticide poisoning. Recent studies have documented a significant threat to fisher from rodenticide poisons commonly used in illegal marijuana plantations (Gabriel 2012, 2012b).

Climate change. The implications of climate change are unclear for fisher. Fisher might benefit by a reduction in deep snow and could benefit by increased mast-producing hardwoods. However, increases in the rate of loss of mature trees with cavities and fragmentation by creating open canopied areas from wildfire could reduce habitat.

Road related mortality. Fisher have been killed along roads by vehicles primarily on Highway 41 where it extends across Sierra NF and Yosemite NP. Some attempts to reduce this risk have included placing signs and reducing speed limits, as well as identifying high priority travel corridors and developing culvert passageways under roads. Some attempts to reduce this risk have included placing signs and reducing speed limits.

Increased predation. Researchers tracking individual animals with radio transmitters have documented fishers being killed by bobcats and other predators. Loss of a few individuals, especially breeding age females, could greatly affect the overall population.

Invertebrates

Federally listed invertebrates

Common Name	Scientific Name	Status
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Threatened

Valley elderberry longhorn beetle

Species Status on the Sierra NF

The range of this species in California consists of patchy distribution from Redding south to Bakersfield, and the western Sierra Nevada foothills to eastern coastal range foothills up to 3,000 feet in elevation. Habitat consists of elderberry shrubs and trees in a variety of habitats and plant communities in the Sierra foothills below 3,000 feet in elevation. Most often, habitat is found in riparian, elderberry savannah or moist valley oak woodlands. This species is most often found along the margins of rivers and streams in the lower Sacramento River and upper San Joaquin Valley. It was more abundant in dense native plant communities with a mature overstory and a mixed understory (Barr 1991). Plants may be associated with riparian zones or moist areas, primarily on north facing slopes scattered throughout the chaparral.

This species is currently under review for delisting due to the increased number of known populations and existing habitat protections in place (USDI-USFWS 2006, USDI-USFWS 2012b). Habitat for this beetle exists in the lowest elevations of Sierra NF. No confirmed reports of these beetles have been reported in the forest, although some potential exit holes in mature elderberry shrubs were found during project surveys (US Forest Service, unpublished NRIS data 2013).

Key Ecological Conditions Needed to Support the Species

Elderberry shrubs and trees. The presence of mature elderberry is important to this species. Potentially suitable elderberry can occur in a variety of habitats.

Key Risk Factors

Loss or disturbance of elderberry. Fire can damage or kill occupied elderberry. The risk of project-related effects are low because projects that may potentially effect elderberry plants are evaluated and designed to avoid elderberry plants or mitigate impacts by planting replacement elderberry plants for those affected..

Plants

Federally listed plants

Common Name	Scientific Name	Status
Keck's checker-mallow	*Sidalcea keckii*	Endangered
Mariposa pussy paws	*Calyptridium pulchellum*	Threatened
Whitebark pine	*Pinus albicaulis*	Candidate

Keck's checker-mallow

Species Status on the Sierra NF

Keck's checkermallow (*Sidalcea keckii*) is not currently known to occur on the Sierra NF. There is a population approximately four miles to the southwest of the forest, in Fresno County (CNDDB 2013). Critical habitat for Keck's checkermallow falls entirely outside of the Sierra NF boundary (USDI - USFWS 2003).

Key Ecological Conditions Needed to Support the Species

Keck's checkermallow is an annual herb that blooms in April and May in clay soils derived from serpentine, usually in open, sparsely-vegetated grasslands. Occurrences have historically been found at elevations between 240 and 1,950 feet in the foothills of the southern Sierra Nevada (USDI - USFWS 2000). If the species were to occur on the Sierra NF, the serpentine-derived soils at Hog Mountain would be the most likely locale. The southeastern flank of Hog Mountain west of Trimmer is the only place on the forest where Delpiedra Family soils are mapped. These are reddish gravelly soils forming a thin layer over re-metamorphosed serpentine. This 690 acre area has been partially surveyed for Keck's checkermallow but not thoroughly enough to ascertain that the species is absent from the forest. Complete surveys during the blooming period in different years to capture different responses to precipitation variation are needed.

Key Risk Factors

When reviewing the summary of factors affecting the species in the listing determination (USDI – USFWS 2000) and updated information regarding these factors in the 5-year review (USDI - USFWS 2007), none are currently valid, as there are no known populations on National Forest System (NFS) lands.

Mariposa pussy paws

Species Status on the Sierra NF

Two occurrences are found about 1.5 miles apart on the Sierra NF in Fresno County (CNDDB 2013). A third occurrence is found along a Forest Service road in Madera County where it traverses Pacific Gas & Electric Company (PG&E) land.

Key Ecological Conditions Needed to Support the Species

Mariposa pussypaws blooms in April through June in chaparral or foothill woodland between 1,300 and 4,000 feet elevation in the central Sierra Nevada foothills (Baldwin et al. 2012). These tiny annual plants are restricted to sparsely vegetated, relatively flat areas, on sandy or gravelly, usually granitic substrates (Guilliams and Clines 2012). In two cases, Mariposa pussypaws occurs on gently sloping hillsides on coarse metamorphic substrate outside the forest (CNDDB 2013). Plants seem to thrive in good rain years where the rocky or gravelly habitat is intact, where there are not excessive non-native annual grasses and forbs, and where the natural hydrology of the gravel flats has not been disrupted by off-highway vehicle travel, cattle trailing, or roads (Guilliams and Clines 2012).

Key Risk Factors

On the Sierra NF, both occurrences are fenced to ensure protection from grazing, off-road vehicle impacts, and damage from transmission line maintenance activities.. For the third nearby occurrence on PG&E land, the forest and PG&E have worked together to place barriers to avoid inadvertent harm from road maintenance or reconstruction, or emergency power line repair or fire suppression activities. Major threats to the occurrences on private land include habitat loss due to development and off-highway recreation, competition from non-native plant species, and possibly atmospheric nitrogen deposition (Guilliams and Clines 2012).

Fire exclusion. For two occurrences outside the national forest, the exclusion of fire, allowing shading by shrubs and other vegetation and the accumulation of duff and surface organic litter, is hypothesized by botanists familiar with this species as a contributor to population declines. In some sites where pussypaws population numbers have dwindled, surrounding native shrubs are growing into and shading the habitat to the extent that the pussypaws no longer thrive. In the sites where this has been observed, there is also an increasing amount of organic matter accumulating on the ground where it was formerly more sandy and open, and there are often more non-native annual grasses than in habitat where the pussypaws are doing best. The re-introduction of fire or experimental cutting back of the surrounding shrubs could be considered to test the hypothesis.

Competition from non-native grasses. This species occurs on soils where nutrients like nitrogen are limiting. Coupled with ground disturbance, increases in nitrogen from livestock and other sources may allow increases in growth in competing grasses (USDI-USFWS 2012c).

Whitebark pine

Species Status on the Sierra NF

Whitebark pine (*Pinus albicaulis*) is known to occur on the Sierra NF as confirmed from herbarium specimens from the California Consortium of Herbaria (UC Berkeley 2013). The herbarium records do not reflect much recent collecting. Over the years, Forest Service botanists have noted whitebark pine as a component of the subalpine plant community during wilderness surveys, but it has not been a focus of attention until recently.

In the Sierra NF as in much of the Sierra Nevada, whitebark pine is often the dominant tree of the subalpine plant community, sometimes forming pure stands and often defining the upper treeline (Fites-Kaufman et al. 2007). Whitebark pine generally occurs on cold and windy, high-elevation sites, resulting in geographically isolated stands (Arno and Hoff 1989). In the Sierra Nevada, stands usually occur between 10,000 and 12,100 feet. Trees can be very long-lived, over 1,000 years old. Healthy whitebark pine stands include coexistence with animals, especially Clark's nutcrackers, birds that disperse the seeds of these trees.

Key Ecological Conditions Needed to Support the Species

Subalpine ecosystems. Intact, functioning subalpine ecosystems are required for whitebark pine to persist over the long term.

Key Risk Factors

Climate change. Like other subalpine species, climate change could pose a substantial risk to whitebark pine as there is likely little opportunity for species migration. In addition, climate change could facilitate the other risk factors of fire and insects and disease.

Fire. Altered fire regime as a result of fire suppression could result in a change in fire intensity or frequency, affecting these long-lives trees.

Insects and disease. Current information suggests that white pine blister rust disease is not a prevalent risk on the Sierra NF to the degree it is in other parts of the Sierra Nevada (Maloney 2011). Similarly, a small amount of mortality from mountain pine beetle has been observed in the Sierra NF, but not at significant levels (Maloney 2011).

Potential Species of Conservation Concern

Species of Conservation Concern are species known to occur on the Sierra NF that the Regional Forester of the Pacific Southwest Region of the Forest Service determines best available scientific information shows a substantial concern about their capability to persist over the long term in the plan area.

The 2012 Planning Rule draft directives describe the process to identify species of conservation concern. A potential list is identified here based on evaluating the species status rankings from the NatureServe ranking system and other criteria that could indicate a substantial concern as defined in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 5, lines 12-53. This list can be modified, based on the best available scientific information and public input during the planning process before approval of the forest plan.

Fish, Amphibians and Reptiles

Potential Species of Conservation Concern - fish, amphibians and reptiles

Common Name	Key Ecological Conditions	Key Risk Factors
Central Valley Hitch *Lavinia exilicauda exilicauda*	Spawning gravel riffles	Water quantity
Hardhead *Mylopharodon conocephalus*	Warm, slow water Clear water	Water quality Water quantity
Kern Brook Lamprey *Lampetra hubbsi*	Cool water, large rivers Gravel-rubble substrate	Water quality Water quantity
Foothill Yellow-legged Frog *Rana boylii*	Partially shaded rocky streams	Water quality Water quantity
Kings River Slender Salamander *Batrachoseps regius*	Logs or rocks with tree overstory Talus slopes	Ground disturbance Water quality Water quantity Fire
Limestone Salamander *Hydromantes brunus*	Cliffs, crevices, ledges, talus slopes, often limestone-based	Ground disturbance Fire Climate change

Common Name	Key Ecological Conditions	Key Risk Factors
Hell Hollow Slender Salamander *Batrachoseps diabolicus*	Rocks Down logs Forest litter	Ground disturbance Fire
Gregarious Slender Salamander *Batrachoseps gregarious*	Oak woodlands Riparian corridors Forest litter	Fire Ground disturbance
Western Pond Turtle *Actinemys marmorata*	Aquatic habitats Shorelines	Water quality Water quantity Shoreline disturbance

Summary of Key Ecological Conditions and Key Risk Factors for Fish, Amphibians, and Reptiles

The key ecological conditions and key risk factors for these potential species of conservation concern can generally be characterized as either aquatic or terrestrial focused. For the primarily aquatic species (Central Valley hitch, hardhead, Kern Brook lamprey, foothill yellow-legged frog, and western pond turtle) the key risk factors are water quality and water quantity. Water quantity and quality can be affected at landscape scales by large changes in climate as well as vegetation such as large, moderate or high severity fire, and by impacts from more chronic changes to hydrology such as roads, landslides, and diversions. Changes can also occur at smaller local sites (streambank impacts from livestock, recreation, roads), which can be important for these species with limited populations or limited habitat. For the more terrestrial salamander species, ground disturbance from a variety of sources could directly impact individuals on the surface cover substrate, such as rocks, logs or forest vegetation litter. They can also be negatively affected by fire, but their habitat may be maintained or improved with the restoration of periodic low severity fire. As these species tend to be fairly localized, trends can only be evaluated in the context of known populations and the suitable habitats within their known or potential range.

Birds and Mammals

Potential Species of Conservation Concern - birds and mammals

Common Name	Key Ecological Conditions	Key Risk Factors
Sierra Marten *Martes americana*	Mature conifer forests Abundant snags and down logs Heterogeneous habitat for cover and prey species.	Habitat loss Habitat fragmentation (large wildfires) Roads (mortality and predator access)
Fringed Myotis *Myotis thysanodes*	Hibernation sites (mines and buildings) Roost sites (caves, mines, buildings, crevices, snags)	Hibernation disturbance Loss of snags Roost disturbance
Townsend's Big-eared bat *Corynorhinus townsendii*	Caves and mines	Roost disturbance (recreation and mining) Pesticides
Spotted Bat *Euderma maculatum*	Roost sites (cliffs, outcrops, talus slopes, buildings) Forest – Riparian interface	Roost disturbance (recreation and mining) Pesticides
Sierra Nevada Mountain Beaver	High elevation riparian and	Recreation and utility development affecting riparian

Common Name	Key Ecological Conditions	Key Risk Factors
Aplodontia rufa californica	wetland areas	habitats. Climate change
Mt. Lyell Shrew *Sorex lyelli*	Riparian and wetland habitats	Meadow drying (roads, historic impacts, water diversions) Livestock grazing
Sierra Nevada Red Fox *Vulpes vulpes necator*	High elevation conifer forests Alpine and subalpine areas (barren and forested) Den sites (talus and boulder fields)	Non-native red fox Recreation developments Climate change
Northern Goshawk *Accipiter gentilis*	Diverse forest habitats for prey Structurally diverse forests for nesting Snags (for prey habitat)	Fire Habitat loss (timber harvest, fire, drought related tree mortality)
Barrow's Goldeneye *Bucephala islandica*	Lakes and Rivers (winter)	Climate change
Mount Pinos Sooty Grouse and great gray owl *Dendragapus fliginosus howardi*	Red fir dominated forests Meadows	Livestock grazing Fire exclusion Disturbance (recreation, project activity) Climate change Loss of edge habitat (timber harvest, fire)
Willow Flycatcher *Empidonax traillii*	Wet meadows with woody riparian shrubs Standing water in meadows	Meadow drying (roads, historic impacts, water diversions) Nest disturbance (predators and nest parasitism) Livestock grazing
American Peregrine Falcon *Falco peregrinus anatum*	Cliffs	Disturbance (rock climbing)
Bald Eagle *Haliaeetus leucocephalus*	Large, old, multi-storied stands for nesting	Disturbance (recreation – summer and winter) Fire
Black-backed Woodpecker *Picoides arcticus*	Abundant snags with abundant insect prey Severely burned older conifer forest.	Post-fire timber harvest Reduction of habitat creation (Insufficient high severity fire due to fire suppression and fuels reduction treatments)
Rufous Hummingbird *Selasphorus rufus*	Mountain meadows with flowering shrubs and forbs	Changes in flowering shrubs and forbs (fire frequency and severity; livestock grazing)
Great Gray Owl *Strix nebulosa*	Meadows and meadow complexes Adequate grass heights for prey Nest trees near meadows	Livestock grazing Fire Disturbance (recreation and livestock) Loss of snags Mortality (Vehicle collisions, West Nile Virus)
California Spotted Owl	Structurally diverse older	Habitat loss (timber harvest,

Common Name	Key Ecological Conditions	Key Risk Factors
Strix occidentalis occidentalis	forests Snags Habitat for prey (flying squirrel and woodrat)	fire, drought related tree mortality) Habitat fragmentation Fire Mortality (Barred owl, West Nile Virus)

Summary of Key Ecological Conditions and Key Risk Factors for Birds and Mammals

The key ecological conditions for these species and the key risk factors affecting those conditions can be generally described as:

- Cliffs, caves, buildings and mines (fringed myotis, Townsend's big-eared bat, spotted bat, American peregrine falcon)

  Risk of recreation-related disturbance to bats in caves, mines, and buildings.

  Risk of recreation-related disturbance (primarily rock climbing) to peregrine falcon at nest sites.

- Meadows (Sierra Nevada mountain beaver, Mt Lyell shrew, Sierra Nevada red fox, Mt Pinos sooty grouse, willow flycatcher, rufous hummingbird, and great gray owl)

  Risk of direct browsing and damage to riparian vegetation and maintenance of meadow conditions. Livestock grazing can affect the key ecological conditions of meadows and riparian areas by changing vegetation height over the summer and by affecting riparian vegetation. Current trends in the number of livestock grazing show a decrease in livestock numbers since the 1960s as summarized in Chapter 8–Range of this assessment. Lingering effects of past meadow impacts remain, especially where water tables have lowered. Some meadows have had active restoration projects.

  Risk of altered forest edge habitat adjacent to meadows. Fire suppression and uncharacteristic wildfire can alter the structure and composition of the forest interface near meadows. Snags and forest cover are important components for great gray owl and heterogeneous forest cover is used by Mt Pinos sooty grouse and Sierra Nevada red fox.

- Structurally diverse mature forests (Sierra marten, northern goshawk, California spotted owl)

  Risk of loss of habitat and habitat fragmentation of conifer forest from wildfire outside the natural range of variability. While the current trends do not show a significant increase in the extent of forest change from wildfire on the Sierra NF, substantial areas are at a low and very low fire resiliency index as described in Chapter 3 of this assessment, indicating they are susceptible to higher amounts of crown fire than expected.

- Large trees and snags (bald eagle, California spotted owl, and black-backed woodpecker)

  Risk of inadequate number, distribution, and quality of large living trees and dead trees (snags) of sufficient density, size, area and age to support key life history needs of

species. Areas with high densities of burned snags created by fire are important for black-backed woodpecker and other species dependent on complex early seral forests. Due to fire suppression, there may be fewer total patches of snags created from fire across the landscape. However, some fire-created patches of snags are exceedingly large and are created from burning older forests which competes with the habitat need for other at-risk species that need large living trees such as the California spotted owl and fisher.

Additionally some risk factors are not directly associated with a key ecological condition. These include:

- Recreation and activity related disturbance (bald eagle and great gray owl). These species are often sought out by recreationists for wildlife viewing but they can be easily disturbed during breeding causing nest failure. They may also be disturbed by management activities.
- Primary roads are a source of direct mortality to some species such as great gray owl and marten.

Invertebrates

Potential Species of Conservation Concern - invertebrates

Common Name	Key Ecological Conditions	Key Risk Factors
A Caddisfly *Anagapetus chandleri*	Primarily high elevation (7,800 ft.) streams and springs	Water quantity Water quality Climate change
A Grasshopper *Hebardacris mono*	Alpine terrestrial habitats	Climate change
Merced Canyon shoulderband (terrestrial snail) *Helminthoglypta allynsmithi*	Variety of terrestrial habitats Movements generally inhibited by water with >30 m width and dry conditions <6 in. rainfall per year.	Drought conditions Climate change
A Caddisfly *Homophylax nevadensis*	Streams	Water quantity Water quality Climate change
Leech's skyline diving beetle *Hydroporus leechi*	Shallow ponds and lakes Pond shorelines	Water quantity Water quality Climate change
A Grasshopper *Hypsalonia petasata*	Alpine habitats	Climate change
Indian Yosemite snail *Monadenia yosemitensis*	Variety of terrestrial habitats Movements generally inhibited by water with >30 m width and dry conditions <6 in. rainfall per year.	Drought conditions Climate change
Orseis Crescent *Phyciodes orseis herlani*	Variety of terrestrial habitats	Uncertain, possibly climate change

Summary of Key Ecological Conditions and Key Risk Factors for Invertebrates

The key ecological conditions and key risk factors for the invertebrate species defined as potential species of conservation concern can generally be focused as either aquatic or terrestrial. For the primarily aquatic species (caddisflies and the Leech's skyline diving beetle) the key risk factors are water quality and water quantity. Water quantity and quality can be affected at landscape scales by large changes in climate, as well as vegetation such as large, moderate or high severity fire, and by impacts from more chronic changes to hydrology such as roads, landslides, and diversions. Changes can also occur at smaller local sites (streambank impacts from livestock, recreation, and roads), which can be important for these species with limited populations or limited habitat. For invertebrate terrestrial species, such as the grasshoppers, butterfly, and snails, ground disturbances from a variety of sources could directly impact individuals on the surface or within substrate cover, such as forest vegetation cover. They can also be negatively affected by fire, but their habitat may be maintained or improved with the restoration of periodic, low severity fire. As these species tend to be fairly localized, trends can only be evaluated in the context of known or potential populations and the suitable habitats within their known or potential ranges.

Plants

Potential Species of Conservation Concern - plants

Common Name	Key Ecological Conditions	Key Risk Factors
Yosemite onion *Allium yosemitense Eastw.*	Rocky slopes Usually metamporphic rock	Mining, trail maintenance
Tulare rock-cress *Boechera tularensis* Windham & Al-Shehbaz	Rock outcrops and rocky slopes > 6000', often near moisture	Mining, trail and road maintenance, fire suppression activities
upswept moonwort *Botrychium ascendens* W. H. Wagner	Moist meadow edges in non-granitic substrates	Trail maintenance
scalloped moonwort *Botrychium crenulatum* W. H. Wagner	TBD Moist meadow edges in non-granitic substrates	Trail maintenance
slender moonwort *Botrychium lineare* W. H. Wagner	TBD Moist meadow edges in non-granitic substrates	Trail maintenance
mountain moonwort *Botrychium motanum* W. H. Wagner	Incense cedar logs in mid-elevation montane meadows and fens	Livestock trampling when meadows are overused
Bolander's bruchia *Bruchia bolanderi* Lesq.	Wet soil in meadows and along streams	Livestock trampling, erosion gullies in meadows
Pygmy Pussypaws *Calyptridium pygmaeum* Parish ex. Rydberg	Dry sandy and gravelly flats above 7500'	Trail maintenance, fire suppression; possibly climate change
Mono Hot Springs evening primrose *Camissonia sierrae* Raven ssp. alticola Raven	Rock outcrops, sandy and gravelly soil above 4500'	Livestock, noxious weeds, trail construction or maintenance, timber harvest, recreation, OHV
Muir's raillardella	Rocky and gravelly sites	Trail and road maintenance, fire suppression activities, timber

Common Name	Key Ecological Conditions	Key Risk Factors
Carlquistia muirii (Gray) B.G. Baldwin		harvest and fuels reduction projects, recreation
tree anemone *Carpenteria californica* Torr.	Ravines and edges of rock outcrops in foothill chaparral	
Bolander's woodreed *Cinna bolanderi* Scribn.	Meadows and streamsides in montane zone	Livestock overuse if it resulted in excessive trampling, trails in meadows, watershed degradation
Mariposa clarkia *Clarkia biloba* (Durand) Nels. & Macbr. ssp. *australis* Lewis & Lewis	Metamorphic soils on steep grassy slopes	Invasive non-native weeds (e.g.yellow starthistle); transmission line maintenance; road maintenance, fire suppression activities
Merced clarkia *Clarkia lingulata* Lewis & Lewis	Metamorphic soils on steep grassy slopes	Invasive non-native weeds (e.g.yellow starthistle); road maintenance, transmission line maintenance; fire suppression activities
Rawson's flaming trumpet *Collomia rawsoniana* Greene	Streamsides and meadow edges in montane zone of Madera County	Watershed degradation, timber harvest, road construction (most threats mitigated by following Species Management Guidelines)
mountain lady's slipper *Cypripedium montanum* Lindl.	Shaded mixed conifer forest	Timber harvest, fuels management, road maintenance, recreation
unexpected larkspur *Delphinium inopinum* (Jepson) Lewis & Epl.	Rocky metamorphic slopes in Monarch Wilderness	Trail maintenance, climate change
Tulare County bleedingheart *Dicentra nevadensis* Eastw.	Rocky sites in upper montane conifer forest (Monarch Wilderness)	Trampling, road maintenance, timber harvest, recreation
Mount Whitney draba *Draba sharsmithii* Roll. & Price	Talus in subalpine forests and alpine fell-fields, on dry granitic sands and gravels, or in protected rock crevices	Trail construction, climate change
Brandegee's woolly-star *Eriastrum tracyi* Mason	TBD	TBD
Hall's daisy *Erigeron aequifolius* Hall	Steep, rocky ridges and in crevices in mixed conifer forests	Possibly competition from non-native invasive weeds (Bromus rubens)
Kings River buckwheat *Eriogonum nudum* Dougl. ex Benth. var. *regirivum* Rev. & J. Stebbins	Carbonate slopes in chaparral and foothill woodland next to Kings River trail	trail maintenance, invasive non-native weeds, natural debris flows
Monarch buckwheat *Eriogonum ovalifolium* var. monarchense	Limestone outcrops, pinyon pine woodland	Non-native annual grasses, climate change, fire suppression activities
Congdon's woolly sunflower	Metamorphic rocks, mostly	Mining, timber harvest and

Common Name	Key Ecological Conditions	Key Risk Factors
Eriophyllum congdonii Brandegee	on steep I slopes in chaparral, foothill woodland, lower montane conifer forest	reforestation practices, road and trail maintenance, residential development, trampling by hikers
manyflower fawnlily *Erythronium pluriflorum* Shevock, Bartel & Allen	Rocky open sites as well as meadow-type sites in red fir/lodgepole forest and in subalpine conifer forest	OHV, livestock trampling, timber harvest, dispersed camping, construction of communications sites (e.g. on Shuteye Peak), flower-pickers
brook pocket moss *Fissidens aphelotaxifolius* Pursell	Rocky open sites as well as meadow-type sites in red fir./lodgepole forest and in subalpine conifer forest	Watershed degradation, fuels reduction, timber harvest, grazing in riparian areas
monarch goldenaster *Heterotheca monarchensis* York, Shevock, & Semple	Dry, open areas in chaparral, with partial to full shade; often with live oaks. Prefers slightly to moderately acidic soils	Clay mining, OHV, fuel breaks, timber harvest and management, invasive species, private development
Parry's horkelia *Horkelia parryi* Greene	Granitic or volcanic soils in openings and under canopy in mixed conifer and red fir forest	OHV recreation, timber harvest, out-of-season burning, fire suppression activities
short-leaved hulsea *Hulsea brevifolia* A. Gray	Dry slopes in cismontane oak woodland and lower montae coniferous forest. Usually in DG, one instance on serpentine	Road maintenance/ construction, invasive plants, excessive grazing/trampling by cattle, OHV recreation
Madera linanthus *Leptosiphon serrulatus* (Greene) J.M. Porter & L.A. Johnson	Rock faces, cracks, and ledges; scree and talus, spoil piles of Barite Mine. Metamorphics or granitics. Chaparral and conifer forest	Road maintenance, mining, mining rehabilitation, horticultural collecting
Congdon's bitterroot *Lewisia congdonii* (Rydb.) J.T. Howell	Rock outcrops and granitic sand and gravel in coniferous forest	OHV, recreation (hiking, trampling, camping). Roads & timber potentially
Yosemite lewisia *Lewisia disepala* Rydb.	Granitic sand and gravel in upper coniferous forest	OHV, dirt bikes, road maintenance
Kellogg's lewisia *Lewisia kelloggii* (K. Brandeg.) ssp. *kelloggii*	Granitic sand and gravel on flats and pans of outcrops, and in coarse soil adjacent to outcrops in conifer forest and foothills	Timber harvest and associated activities, OHV, invasive non-native weeds, road maintenance and construction
orange lupine *Lupinus citrinus* Kell. var. *citrinus*	Meadows, sub-alpine coniferous forests on mesic rocky sites	Trail maintenance
Hockett Meadows lupine *Lupinus lepidus* Dougl. ex Lindl. var. *culbertsonii* (Greene) C.P. Sm.	Saturated meadows in upper mixed conifer forest	Any activities that alter meadow hydrology, livestock trampling
broad-nerved hump-moss *Meesia uliginosa* Hedw.	Metamorphic, sedimentary, limestone, or serpentine soils with high copper content, foothills	

Common Name	Key Ecological Conditions	Key Risk Factors
elongate copper moss *Mielichhoferia elongate* (Hoppe &Hornsch. Ex Hook) Nees & Hornsch. In Nees et. Al	Metamorphic rocks and in woodlands on gravelly soil among rocks containing heavy metals	Road maintenance or widening, mining
Shevock's copper moss *Mielichhoferia shevockii* (A.J. Shaw) A.J. Shaw	Open gravelly areas in chaparral, ponderosa pine forest (often in burns and disturbed areas)	Timber harvest, road maintenance or construction, cattle trampling, OHV, dispersed camping, noxious weeds, residential development
slenderstalk monkeyflower *Mimulus gracilipes* Robinson	Marble ledges in foothills	Possibly competition by non-native annual grasses and other invasive weeds
Kaweah monkeyflower *Mimulus norrisii* Heckard and Shevock	Aquatic: submerged rocks in streams with good water quality	Excessive sedimentation or eutrophication caused by traffic or livestock
pansy monkeyflower *Mimulus pulchellus* (E. Greene) A.L. Grant	Carbonate or granitic, rocky substrates in coniferous forests	Recreationists
Goward's waterfan *Peltigera gowardii* Lendemer & H. O'Brien	Wet montane meadows and fens	Overuse of meadows by livestock, watershed degradation
marble rockmat *Petrophyton caespitosum* (Nutt.) Rydb. ssp. *acuminatum* Munz	Rocky or sandy soils in Tehipite Valley	Trail maintenance, invasive non-native plants.
Yosemite bog orchid *Plantanthera yosemitensis* Colwell, Sheviak & P.E. Moore	Rocky sandy soil on Patterson Mountain	Communication site or road maintenance
Tehipite Valley jewelflower *Streptanthus fenestratus* (Greene) J. Howell	Montane meadows between 6800 and 7300’	Overuse of meadows by livestock, watershed degradation
Howell's tauschia *Tauschia howellii* (Coult. & Rose) Macbr.	Rocky slopes Usually metamporphic rock	Mining, trail maintenance
Bolander's clover *Trifolium bolanderi* Gray	Rock outcrops and rocky slopes > 6000’, often near moisture	Mining, trail and road maintenance, fire suppression activities

Summary of Key Ecological Conditions and Key Risk Factors for Plants

The key ecological conditions and key risk factors for the plant potential species of conservation concern are still being synthesized at the time of the draft Sierra NF Assessment. This information will be available in the final assessment. All are known to occur on the Sierra NF based on records in the California Natural Diversity Database (CNDDB 2013) and Sierra NF field survey and GIS data.

Overall Summary of Key Ecological Conditions and Key Risk Factors

Climate change is a key risk factor that applies either directly or indirectly to all at-risk species. A summary of current conditions and trends related to climate change is provided in Chapter 3 of this assessment. These species are identified as at-risk due to low population size, low amounts of suitable habitat, or substantial threats to populations or habitats. The projected changes in both habitats and

ecological processes that may result from climate change could have a disproportionate impact on at-risk species as they may be less able to respond to changed conditions or be robust enough to recover from abrupt climate-related changes. For example, small localized populations or limited habitat could be effectively eliminated by a single large wildfire event with little opportunity for re-colonization from adjacent areas over time as habitats recover. For aquatic species, changes in types and patterns of precipitation, particularly rain and snowfall patterns, could alter key life cycle sequences. For example, the Yosemite toad is strongly tied to standing water in meadows for breeding during a short breeding season. If patterns of snowfall change, toads may emerge from hibernation sooner. This could expose them to predators for longer periods. Breeding appears to be timed to coincide with optimal water conditions for egg laying and metamorphosis when adequate prey supports rapid growth. Climate change could alter any of these important conditions, resulting in lowered breeding success or increased mortality. As each species has a unique set of environmental relationships, this assessment defers to the more detailed species accounts when detailed life history and threat information is needed to support developing and evaluating potential plan components.

Fire is another key risk factor that applies to many at-risk species and current conditions and trends are described in Chapter 3 of this assessment. Habitats for at-risk species in the large area of the Sierra NF at low to mid-elevations where fires have burned less frequently than historically that also have low or very low wildland fire resilience have a higher potential to experience adverse habitat change from future large wildfires. See Chapter 3 of this assessment for more detail and maps. The implications of this habitat change depend on the specific habitat types used or required by each species, and the amount and extent of remaining suitable habitat in burned areas, along with the post fire rate of vegetation recovery. Wildfires that burn large areas of structurally diverse older forests at moderate and high severity generally reduce high quality breeding habitat for species such as California spotted owl, northern goshawk, and marten over the long term, but would increase high quality nesting and foraging habitat for the black-backed woodpecker in the short term.

Livestock grazing is a key risk factor for many aquatic species, several plant species and a few vertebrate species, especially those associated with meadows and riparian areas. Trends in the number and permitted use by livestock are presented in Chapter 8 – Range of this assessment. Current numbers on the Sierra NF are reduced by approximately half of those permitted in the 1960s. Conditions in meadows and riparian areas have generally been improving and most measures of rangeland condition do not appear to indicate substantial declining trends. For more specific information on wetland index, key meadow condition, soil cover, properly functioning condition, and annual grassland condition see the summary in Chapter 8 – Range of this assessment. Regardless of these general conditions and trends, conditions and trends for each species should be evaluated in the context that several at-risk species have limited ranges or specific habitat requirements and low population numbers. This level of detail is not readily available for consideration in this assessment.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The presence of at-risk species in the plan area affects management decisions. For federally listed species, projects are generally designed to maintain or enhance habitat and to avoid or mitigate potential effects to individuals in order to comply with the Endangered Species Act. This can increase the time and cost for project planning if species inventory is needed, or if additional work is needed to assess habitat conditions before making a project decision. In addition, procedures to ensure appropriate regulatory

oversight, provided by the U.S. Fish and Wildlife Service and NOAA Fisheries, are factored into project level planning when federally listed species could be affected. This can impact the rate and pace for designing and implementing projects aimed at ecological restoration.

However, specific funding exists for projects designed to enhance at-risk species habitats or reduce threats to at-risk species, and often projects with an objective to benefit at-risk species are given a priority for funding or emphasis. Partnerships with other agencies and stakeholder groups are often focused on benefitting at-risk species. This can increase support for projects aimed at ecological restoration that reduce threats for at-risk species. Implementation of habitat improvement projects designed to benefit at-risk species can contribute to the local labor force and economy when work is accomplished through contractors.

The presence of some charismatic at-risk species, such as bald eagle and Sierra Nevada bighorn sheep, contributes to the recreational activity of viewing nature, which contributes to the local recreation economy. Data from the National Visitor Use Monitoring program for 2007 showed that viewing wildlife was a popular reported recreation activity on the Sierra NF at 22 percent. Often the presence of these highlight species increases the appeal of an area for nature watchers, even if they do not specifically seek these species out.

While most at-risk species are protected, Lahontan cutthroat trout are managed by the California Department of Fish and Wildlife to provide limited catch-and-release fishing that contributes a unique recreation opportunity for anglers to directly encounter a threatened species The purchase of fishing licenses supports management and conservation of wildlife resources by the California Department of Fish and Wildlife throughout the state, including on the Sierra NF.

Management for at-risk species can be used as an indicator of sustainability of forests related to the conservation of biological diversity (USDA-USFS 2011). The trends in the species diversity indicators are provided in Chapter 1 of this assessment.

Information Gaps

Systematic inventories to document the contemporary presence or absence of most at-risk species do not exist. Historic distribution and historic population estimates are not known for most species, although more data generally exists for federally listed species. General accounts from the last 100 years from naturalists, and studies from recent decades allow extrapolation of abundance and distribution. This information gap must be considered in the context of the current, admittedly altered, drivers and stressors. In many cases, due to human encroachment into the wildlands, the permanent or semi-permanent alteration of habitats due to land use changes, and the fundamental alteration of drivers and stressors, restoration to historic species distributions and population levels cannot be realistically attained.

Similarly, key life history information is lacking or has not been synthesized into a readily available format for some species. This is particularly true for invertebrates for the draft of this assessment. Additional information will be sought for inclusion in the final assessment and throughout the planning process, as needed

Information for the potential list of plant species of conservation concern exists and will be included in the final assessment. It was not able to be incorporated into this draft.

For most amphibian species, a variety of fungal pathogens as a disease agent are a significant concern for population sustainability. These diseases are the focus of many recent and ongoing research efforts. As research information accrues and causal relationships are established, the significance of disease as a key factor can better be evaluated.

The direct and indirect cause-and-effect relationships between the effects of disturbance to individuals and from changes in habitats that may cause either positive or negative changes in survival, mortality, and breeding rates does not exist for most species.

Chapter 6: Assessing Social, Cultural and Economic Conditions

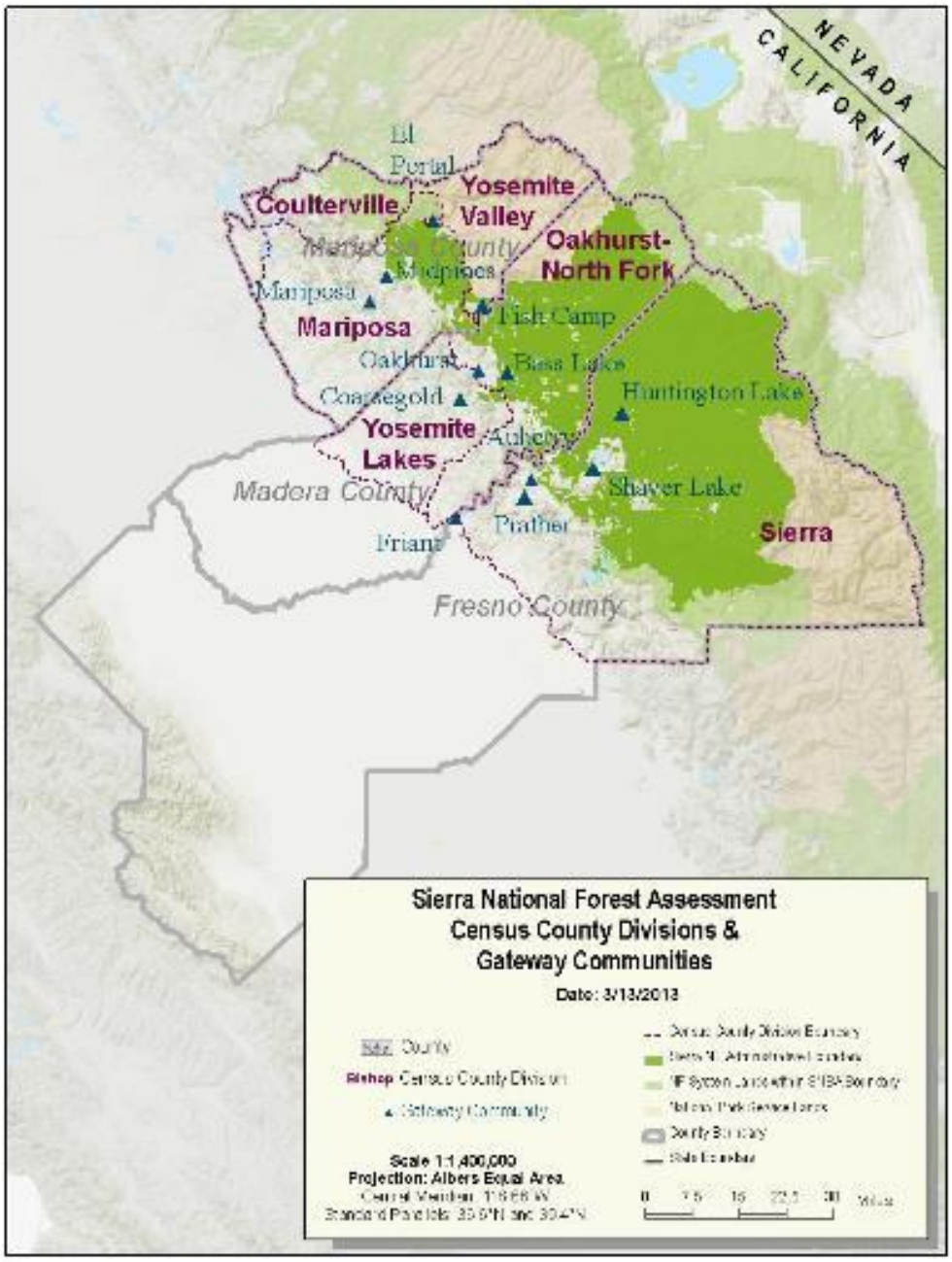
The 2012 Planning Rule recognizes that social, economic, and ecological systems are interdependent. As such, it requires the consideration of social, economic, and ecological factors in all phases of the planning process. National forest management can influence social and economic conditions relevant to a planning area, but cannot ensure social and economic sustainability, because many factors are outside the control and authority of the responsible official. For that reason, the 2012 Planning Rule requires that plan components contribute to social and economic sustainability within Forest Service authority, and the inherent capability of the plan area. To accomplish this goal, it is necessary to understand the context of socioeconomic conditions for the Sierra NF. This chapter summarizes this context,

Important Information Evaluated in this Phase

This chapter focuses on assessing social, cultural, and economic conditions in the Sierra NF assessment area. However, conditions outside the assessment area can also impact the forest and conversely, management decisions on the forest can have impacts far beyond the plan area. Therefore, a layering of these scales will be considered and incorporated throughout the chapter where applicable and will provide a more complete picture of the socioeconomic conditions in the Sierra NF assessment area. Conditions in the assessment area will be compared to conditions in the Sierra Nevada bio-region, California, and the United States as a whole.

Assessment Area

This chapter presents socioeconomic data for the Sierra NF assessment area, defined here as the six census county divisions (CCDs) from the three counties that intersect the forest administrative boundary: Mariposa, Merced and Fresno. The figure below displays this. These counties also have large portions of land area that lie outside of the plan area. Therefore, using data for these CCDs rather than for the entire county provides a closer fit to the geographical footprint of the plan area. However, data from the counties is also presented as a whole to allow for a comparison of county conditions to the more local forest conditions. In some cases, such as with the economic portions of this chapter, CCD-level data are not available for many variables and therefore only county-level data is presented.



Sierra NF assessment census county divisions and gateway communities

In addition to CCD- and county-level information, socioeconomic data for gateway communities in the assessment area is presented. Gateway communities are communities that exist in close proximity to the Sierra NF whose residents and elected officials are often affected by the decisions made in the course of managing the forest, and whose decisions may affect the resources of the forest. Because of this, there are shared interests and concerns about decisions. These gateway communities typically offer food, lodging, and other services to forest visitors and provide opportunities for employee housing, and a convenient location to purchase goods and services essential to forest administration (definition adapted from the National Park Service) (National Park Service 2006).

Data Sources

A primary source of socioeconomic data for assessment area, including population, age, gender, race, ethnicity, language, education, housing, poverty levels, household earnings, and employment were taken from the Economic Profile System – Human Dimension Toolkit (EPS-HDT) developed by Headwaters Economics in partnership with the Bureau of Land Management and the Forest Service. Another important source of information was the "Science Synthesis to Support Land and Resource Management Plan Revision in the Sierra Nevada and Southern Cascades," developed by the USDA Forest Service Pacific Southwest Research Station (Long et al. 2013).

For more detailed information on the data sources used see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 18-92.

Nature, Extent and Role of Existing Conditions and Future Trends

This section summarizes: (1) the social, cultural, and economic context of existing conditions and future trends on the Sierra NF and (2) the social, cultural, and economic conditions that are influenced by forest management. Examining social, cultural, and economic conditions and trends from both perspectives is useful for understanding the environment in which decisions are made but may not be substantially influenced by the management of the plan area.

Social, Cultural, and Economic Context of the Sierra NF

The focus of this section is to provide the social, cultural, and economic context of existing conditions and future trends for the Sierra NF. It includes information on history and culture, population, demographics, settlement patterns and housing, human wellbeing, economic health, and economic diversity. This context is important because it influences national forests and forest management. While forest management can influence social, cultural, and economic conditions, larger socioeconomic forces may influence the agency's decisions and outcomes and, therefore, the ability to influence some of these conditions.

Historical Context

Similar to the Sierra Nevada bio-region, the Sierra NF has a rich history and culture that has always been deeply connected to the land and its natural resources. The Sierra NF has been home to Native Californian people for at least 13,500 years. The Gold Rush of 1849 resulted in an influx of people who affected the area and its inhabitants by introducing commodity production. By the late 19th century, tourists and adventurers were coming to the Sierra NF to fish the lakes, relax at tourist ranches, and hike

and camp in the beautiful Sierra Nevada Range. The Sierra NF is recognized for providing for public needs of wood, water, electricity, and recreation for more than a century.

For more detailed information on this historical context see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 103-126.

Cultural Context

The cultural conditions in the Sierra Nevada in general are deeply tied to the area's rich past and can influence how National Forest System (NFS) lands are used and managed. The Native American population is estimated to make up approximately 3.1 percent of the total population within the Sierra NF's assessment area. This compares to 1.4 percent at the bio-regional level and 0.8 percent at both state and national levels. Over 40 percent of the Native American population in the assessment area is located in the Sierra CCD. The assessment area accounts for about 5 percent of the total Native American population in the Sierra Nevada bio-region. Because most of the tribes in the Sierra Nevada have an insignificant land base or none at all, they have to do most of their gathering on public lands (Anderson and Moratto 1996). Native American culture is inextricably connected to the land and relies on the forest and its resources to maintain that culture.

Timber harvest is also a part of the bio-region's cultural heritage and has played a lasting role in shaping community values and identities. Timber communities have a strong sense of place and value close community ties, community self-reliance, and individualism (Kusel 1996). Timber under contract on the Sierra has declined over the last 25 years. Currently, the Sierra NF is providing timber for three remaining sawmills.

Ranching and agricultural lands are an integral part of the region's economy, history, cultural heritage and scenic beauty (Sierra Nevada Conservancy 2011a and 2011b). Ranchers continue to depend on public land grazing to support their livelihood. The central Sierra foothills are home to many ranchers who have long practiced a system of grazing where they move their livestock seasonally, using the foothills in the winter and Forest Service montane meadows in the summer (Sulak and Huntsinger 2007). Ranching has declined due to shifts in land management priorities, societal pressures that have resulted in new policies, reduced rangeland forage production, competing land uses, family demographics, and the marginal economics of livestock grazing (Huntsinger et al. 2010). In 2012, 22 permits were authorized to graze 3,370 cattle within the plan area at various times throughout the year.

Outdoor recreation is a large part of the culture and lifestyle in the Sierra Nevada and one of the main ways that residents and visitors connect to the land and enjoy the natural world. Recreation plays a significant role in contributing to tourism in the region, which relies on the condition of Sierra Nevada ecosystems (Duane 1996). According to National Visitor Use Monitoring (NVUM) data from fiscal year (FY) 2007, which is the latest round of surveys, an estimated 1.18 million people visited the Sierra NF. Of the 10 national forests in the bio-region, the Sierra NF was the sixth most visited forest for recreation. In FY 2007, key visitor activities on the Sierra NF were: viewing natural features, relaxing, hiking and walking, other non-motorized activities, viewing wildlife, and picnicking. Many visitors came from outside the immediate CCD assessment area, with about 40 percent of visitors traveling between 51 and 100 miles, and about 33 percent traveling more than 100 miles. Over half of the visitors originated from the three-county area with a substantial portion coming from southern California as well.

For more detailed information on this cultural context see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 127-275.

Population

According to the Sierra Business Council (2007), population growth is the driving force of change throughout the Sierra Nevada. The population in the Sierra NF assessment area grew by 10.1 percent between 2000 and 2010 to 66,259 people. This is less than the 14.6 percent increase that occurred at the bio-regional level and greater than the 8 percent increase at both state and national levels during the same time period. Within the assessment area, the largest growth in population (28.7 percent) occurred just west of Yosemite National Park in the Coulterville CCD of Mariposa County. A noticeable decline in population of 35.5 percent occurred in the Yosemite Valley CCD of Madera County. By 2050, the population is expected to increase 25 percent in Mariposa County, 108 percent in Madera County, and 65 percent in Fresno County (California Department of Finance 2012a).

For more detailed information on population see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 276-308.

Demographics

The age distribution in the assessment area shifts to older age classes compared to the Sierra Nevada bio-region, state, and country as a whole. In 2010, the segment of the population older than 60 was 28 percent in the assessment area, compared to the 18 percent in the bio-region, 15 percent in the state, and 18 percent in the country. The Oakhurst-North Fork CCD had the greatest proportion of people who were over 60 (32 percent).The one exception in the assessment area is the Yosemite Valley CCD, where Yosemite National Park is located and where 42 percent of the population is between 20 and 39 years old.

Within the assessment area, there is less racial and ethnic diversity than at all other geographical scales. In 2010, 10 percent of people in the assessment area identified as Hispanic or Latino (of any race), compared to 29 percent in the bio-region, 37 percent in the state, and 16 percent in the country as a whole. Racial diversity is also lower in the assessment area, where 88 percent of people are White, compared to 75 percent in the bio-region, 61 percent in California, and 74 percent in the country. The Yosemite Valley CCD appears to have more diversity than the other CCDs in the assessment area. However, the story is quite different outside the immediate assessment area. Examining the entire three-county region that intersects the Sierra NF reveals a much larger percentage of people who are Hispanic or Latino, as well as a racial makeup that is more similar to that of California.

According to National Visitor Use Monitoring (NVUM) data from fiscal year 2007, 10 percent of visitors to the Sierra NF were minorities. Expanding beyond the assessment area to the three-county region that intersects the forest shows minorities account for 36 percent of the population. People who are Latino or Hispanic accounted for 17 percent of visitors in 2007, which is greater than the proportion of Latinos or Hispanics living in the assessment area (10 percent), but fewer than the proportion living in the larger three-county region (49 percent), bio-region (29 percent), or the state as a whole (37 percent).

For more detailed information on demographics see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 309-367.

Settlement Patterns and Housing

Population and settlement growth in the bio-region has largely been driven by a phenomenon known as amenity migration, referring to the movement of people from urban areas to Sierra Nevada forests for their amenity values, such as outdoor recreation opportunities, scenic beauty, and an overall improved quality of life (Loeffler and Steinicke 2007). In the assessment area, over 50 percent of the homes in the Yosemite Valley CCDs are seasonal homes. In addition, 20-30 percent of the homes in the Sierra, Oakhurst-North Fork, and Coulterville CCDs are seasonal homes. The growth in new homes since 1990 in the Yosemite Lakes CCD has been greater than the other CCDs in the assessment area, and greater than the growth of new homes at other scales.

Approximately 47 percent of people who own homes in the assessment area have monthly costs (mortgages, real estate taxes, various insurances, utilities, fuels, mobile home costs, and condominium fees) greater than 30 percent of their household income, which is considered a proxy for unaffordable housing. This is slightly lower than levels in California (52 percent) and the bio-region (48 percent), and higher than the national level (37 percent).

For more detailed information on settlement patters and housing see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 368-412.

Human Wellbeing

Poverty rates in the Sierra NF assessment area are lower than the bio-region as a whole. In 2010, the poverty rate in the assessment area was about 10 percent for individuals and 7 percent for families, which compares to 17 percent and 12 percent respectively in the bio-region. Just beyond the assessment area in the remaining parts of the counties that intersect the Sierra NF, poverty rates are much higher. Minorities generally account for a greater percentage of the poverty rate than their representation in the total population.

About 90 percent of people in the assessment area have a high school degree, which is higher than bio-regional (82 percent), state (81 percent), and national (85 percent) levels. However, a greater proportion of people have a bachelor's degree or higher at state (30 percent) and national (28 percent) levels than in the assessment area (22 percent) and bio-region (23 percent). The Coulterville CCD has a noticeably low proportion of people with a post-secondary education. The Yosemite Valley and Yosemite Lakes CCDs have relatively high percentages of people with a post-secondary degree.

According to the University of Wisconsin Population Health Institute's County Health Rankings (2013), Mariposa County is ranked 26th out of 57 in health outcomes. Health outcomes represent how healthy a county is based on how long people live and how healthy people feel while alive. In terms of health factors, Mariposa County is ranked 25th. Health factors represent health behaviors, clinical care, social and economic factors, and physical environmental factors that influence the health of a county. While the health outcomes rank represents how healthy a county currently is, the health factors rank addresses how healthy a county might be in the future based on the many factors that influence health. Madera County's overall rank is 37th out of 57 for health outcomes, and 52nd out of 57 for health factors. Fresno County's overall rank is 46th out of 57 for health outcomes, and 54th out of 57 for health factors.

According to 2011 data from the Center on Juvenile and Criminal Justice (2012), Mariposa County has a relatively low crime rate compared to the rest of the state with 2,344 crimes (aggravated assault, forcible rape, murder, robbery, arson, burglary, larceny-theft, motor vehicle theft) reported to the police per

100,000 adults age 18-69. Madera County's reported crime rate is 3,038, close to the state average. Fresno County's reported crime rate is 5,083, which the second highest in the state. A major increase in reported crime rates occurred from 2010 to 2011 across all three counties and the state as a whole. Mariposa County has a low juvenile felony arrest rate, which has dropped considerably since 2010. Madera and Fresno Counties both have juvenile felony arrest rates that are close to the state average and have remained relatively stable when compared to 2011 levels.

For more detailed information on human well-being see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 413-489.

Economic Health

The unemployment rate in 2011 for the counties bordering the Sierra NF was 16.3 percent, higher than both the bio-region (14.3 percent) and the state (11.7 percent). In addition, 2011 average earnings in these counties ($48,970) as well as per capita income ($31,839) were lower than in both the bio-region ($51,744 earnings and $36,127 per capita income) and the state ($61,799 earnings and $44,564 per capita income). With higher unemployment, lower earnings and lower per capita income, the counties bordering the Sierra NF face greater challenges to economic health than the state and bio-region as a whole.

For more detailed information on economic health see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 520- 555.

Economic Diversity

For the economic context of forest management decision making, it is important to identify the key sectors that drive the economy, and the extent to which the economy is dependent on forest activities. Determining this level of diversification and the economy's dependence on these forest activities provides a good measure of the potential effects that may result from forest management decisions that impact these activities. The economies of the assessment area are diversified except in the Yosemite Valley CCD where the travel and tourism sectors account for more than half of all employment (Lin and Metcalfe 2013). The diversity of these economies will be impacted by future trends and changes in employment levels across economic sectors. Employment projections by occupation show that the greatest increases over this decade are expected in the healthcare, personal care and service occupations, while travel and tourism is expected to grow at around 4.5 percent (California Department of Finance 2012b). This increase is slightly below the average for all occupations as a whole (5.1 percent) and this suggests that future trends in employment will not lead to an increased concentration of employment in this sector.

For more detailed information on economic diversity see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 556-615.

Gateway Communities

The gateway communities identified for the Sierra NF include: Oakhurst, Coarsegold, Mariposa, Midpines, El Portal, Shaver Lake, Bass Lake, Fish Camp, Auberry, and Friant. Other communities, including North Fork, Prather, Huntington Lake, and Tollhouse may also be considered gateway communities; however, data for these communities were not available through the American Community Survey. These communities are small in population ranging from 3,263 in Oakhurst to 378 in El Portal. They have a similar racial make-up, with White comprising over 80 percent of all the population in each community except El Portal (70 percent). Unemployment is 6 percent or below in all communities except

Midpines at 15 percent. Median household income varies dramatically from a high of $115,000 in El Portal to a low of $21,000 in Friant, and poverty follows a similar pattern.

For more detailed information on these gateway communities see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 616-620.

Social, Cultural and Economic Conditions Influenced by the Forest Service

This section identifies key social, cultural, and economic conditions influenced by management of the Sierra NF. Many of the conditions previously identified provide useful context, but may not be substantially influenced by the management of the plan area to be included here. Where information is available, trends affecting these conditions are identified. At the end of this section, potential opportunities that may exist for the Sierra NF to contribute to social, economic, and ecological sustainability are discussed.

Connecting with the Land

Many people in the Sierra Nevada feel a deep connection to the land and its history. As described in Winter et al. (2013a, p.2) “attachment to the natural environment, influenced by natural landscapes and views, presence of wildlife, and opportunities for outdoor recreation is a component of community attachment and well-being."” National forests in the Sierra Nevada play a major role in fostering people’s connection to nature, particularly through recreation, education, and interpretation.

According to National Visitor Use Monitoring (NVUM) data from fiscal year 2007, the most popular recreation activities on the Sierra NF included viewing natural features (49 percent), relaxing (48 percent), other non-motorized recreation activities (44 percent), hiking/walking (41 percent), viewing wildlife (22 percent), and picnicking (20 percent). Visitor satisfaction from NVUM data can provide some sense of people’s ability to connect to the land through the quality of their experiences. Overall visitor satisfaction in 2007 was high on the Sierra NF: 73.8 percent of visitors were very satisfied with their visit and 19.8 percent were somewhat satisfied.

For more detailed information on connecting with the land see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 629-729.

Social Interactions

Being with friends and family is one of the main motivations for why Californians pursue outdoor recreation opportunities (Roberts 2009). In November 2012, the Forest Service, through its Central California Consortium (CCC) held a youth workshop in Clovis, California. The goal was to have a discussion with youth and underserved communities about forest planning, why it matters to them, and ways to get young people and their families involved. A recurring response was that being with friends and family made them happy, and forests provide opportunities for spending time with friends and family. The Forest can also help connect people to each other and build community capacity through community-based collaboration.

For more detailed information on social interactions see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 730-785.

Health, Safety, and Education

The Sierra NF contributes to the well-being of human populations in a variety of ways. Forests offer physical and mental health benefits (Karjalainen et al. 2010). Forests provide the basic necessities of life, including clean air and water. Agency strategies can influence community safety and well-being through efforts to manage and recover from fires and to help communities prepare for and understand wildland fires (McCool et al. 2007). The Forest can also provide educational and skill-building opportunities for youth through programs such as the Youth Conservation Corps and Central California Consortium.

Community Values

Many Sierra Nevada residents share values around the rural and environmental qualities to which National Forest System lands contribute. Maintaining the rural character of the region is important to these residents (Sierra Business Council 1997). The Whisky Ridge Project lies within the Willow Creek watershed on the Sierra NF. A broad group of individuals and groups with a relationship and interest in the community and forest area reached consensus on core values and beliefs. Examples of these include: the forest as a sacred place that should be respected as a whole, management for future generations, biodiversity and complex forest communities, fire as an integral process, and dependence of humans on functioning ecosystems (Willow Creek Planning Collaborative 2012).

For more detailed information on community values see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 851-952.

Cultural Connections

Sierra Nevada national forests provide opportunities for people to connect with the history and culture of the region, and to create new contributions to the region's culture and future legacy. The Sierra NF contributes to these opportunities through its cultural and historical resources. Key examples include the Dinkey Creek Bridge and the Sierra Heritage Scenic Byway as well as historical places and events in communities such as Clovis, Prather, Pineridge and Shaver. The Sierra NF also offers many interpretive trails and sites that help tell the story of the area and its cultural history including The Way-of-The-Mono Interpretive Trail and the Ross Cabin Interpretive Site and Nelder Grove, a giant sequoia grove located in the center of its natural geographic range. According to 2007 NVUM data, 4.8 percent of visitors to the Sierra NF visited historic sites, and 1.6 percent cited this activity as the main reason for visiting a forest.

For more detailed information on cultural connections see the July 2012 snapshot of the Sierra NF Living Assessment Chapter 6, lines 953-1016.

Traditional Uses

In the Native American community, subsistence use of forests denotes a lifestyle involving a deep connection to nature and cultural traditions (USFS 2011). Many Native Americans participate in traditional activities, such as hunting, fishing, trapping, and gathering berries, and do not differentiate these activities into distinct categories, such as work, leisure, family, culture, and tradition (McAvoy et al. 2004). On the Sierra NF, these include access and use of Forest Service roads that access Rancheria lands, protection of the Merced, Willow Creek, San Joaquin and Kings River watersheds, and protection of Rancheria and allotment lands from fires that start in the forest. Non-tribal groups also use the Sierra NF for traditional and cultural purposes. According to 2007 NVUM data for the Sierra NF, 4.3 percent of visitors participated in gathering forest products and 3 percent of visitors reported it as the main reason for visiting the forest. However, the data do not differentiate between tribal and non-tribal gathering.

For more detailed information on traditional uses see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1017-1091.

Economic Conditions

Contributing to community well-being by providing a broad range of economic opportunities for forest communities is consistent with current direction from the U.S. Department of Agriculture (USDA) to generate jobs through recreation and natural resource conservation, restoration, and management in rural areas (USDA 2010). However, federal forest management alone cannot ensure community stability as jobs in the forest products and recreation industries are influenced by market conditions and changes in technology outside the control of forest management. As a result, national forests cannot expect to ensure community economic wellbeing through their management actions alone (Charnley 2013). Strategies can be developed to achieve management objectives while considering the effects on local wellbeing. Timber, recreation and agricultural production on National Forest System lands continue to make important contributions to some local communities.

Timber and Mining

As of 2010, timber sector jobs in the counties bordering the Sierra NF made up a small percentage of total private sector employment. Timber employment accounted for around 0.6 percent of all private sector jobs in the counties (an estimated 1,474 jobs out of the 252,597 county jobs), which is a similar percentage to the state and the bio-region. Within the timber sector, wood products manufacturing accounts for most of this employment (1,342) with very few jobs occurring in sawmills and paper mills (105) and in the growing and harvesting industries (27) . Total employment in the timber sector has decreased from around 0.8 percent of all private sector employment in 1998 to 0.6 percent level today (Headwaters Economics 2012a). The closing of the North Fork Mill (with an estimated 145 employees) contributed to this decline. Current planning efforts are underway to redevelop this mill site to fuse biomass generated by forest management, specifically bioenergy generation (NFCDC 2013). Currently, the Sierra NF provides timber for three remaining sawmills: Sierra Forest Products in Terra Bella, California, and Sierra Pacific Industries in Chinese Camp, California and Standard, California. The Terra Bella mill is the last remaining mill south of Yosemite in California.

The 2011 annual wage averaged across all economic sectors in these counties is $38,042, which is lower than the state average of $55,005 and the bio-region average of $42,776. The average annual wage for timber employment in these counties is $44,756, the same as the $44,759 average earned in the bio-region. Paper manufacturing pays the highest wage in the timber sector ($54,293) and wood products manufacturing pays the lowest ($32,557) (Headwaters Economics 2012a).

Mining sector jobs in 2010 in the counties bordering the Sierra NF made up a smaller percentage of total private sector employment than did timber. This mining employment accounted for 0.1 percent of all private sector jobs in the counties (an estimated 187 jobs out of the 252,597), which is slightly less than the state and the bio-region. Non-metallic minerals and mining accounts for most of this employment (140) and only a few jobs occur in the oil and gas extraction and the metal ore mining industries. Total employment in the mining sector has been somewhat stable comprising 0.2 percent of all private sector employment in 1998 to 0.1 percent today. The average annual wage for mining employment in these counties is $81,511 which is much higher than the average wages across all sectors ($38,042). This high average wage for mining is similar to the bio-region and indicates that the number of jobs in the mining

sector may be low but they are relatively high paying jobs when compared to the rest of the local economy (Headwaters Economics 2012a).

Agriculture

Pasture and rangelands within the counties bordering the Sierra NF comprise 40 percent of the total land area in farms, which is less than the percentage for the state (52.3 percent) and the bio-region (53.0 percent) (USDA 2009). Cattle, sheep and goats, which are the types of animals primarily grazed on public lands, account for around 14.6 percent of all farming operations, less than the bio-region (22.5 percent) but similar to the state (17.5 percent) (USDA 2009). Farm employment in these counties accounts for 5.2 percent of all employment, higher than for the bio-region (3.2 percent) and the state as a whole (1.2 percent) (U.S. Department of Commerce 2012). Limitations of this employment data include the fact that farm employment cannot be broken down by type of activity so this specialization includes all types of agricultural employment, not just grazing and livestock operations.

Recreation and Tourism

In 2010, travel and tourism industries comprised 15.9 percent of jobs in the counties bordering the Sierra NF, which is similar to the bio-region (18.1 percent) and the state (15.7 percent) (U.S. Department of Commerce 2012). An important attraction drawing visitors to this area is the Chukchansi Gold Resort and Casino operated by the Picayune Rancheria of Chukchansi Indians. The number of jobs in this sector has been relatively stable, around 15 percent of total private employment from 1998 through 2010. The average annual wage in the travel and tourism sector is $16,994, far below the $38,042 average for all private sector jobs. While the travel and tourism sector may provide employment opportunities in the area, they are relatively lower paying jobs (Headwaters Economics 2012a).

A study examining the value of travel and tourism to California counties estimated the percentage of total county employment and earnings generated by all travel in the county. Travel and tourism is an important sector in Mariposa County, accounting for 52 percent of employment and 33.4 percent of earnings. These percentages are lower in Madera (5.2 percent of employment and 3.0 percent of earnings) and Fresno (2.9 percent of employment and 1.5 percent of earnings) Counties (Dean Runyan and Associates 2012). A study looking specifically at contributions from recreational use of National Forest System land found that employment created by recreation activities specifically on the Sierra NF in 2008 was only a small percentage of the local economic activity surrounding the forests (0.19 percent of total employment and 0.15 percent of total income in the area) (USFS 2008).

The Importance of Water to Economic Sectors

Examining the flow of water from the Sierra NF shows the economic importance of this ecosystem service. This water flow feeds 10 water storage facilities and 22 operationally active hydroelectric facilities within or near the forest.

Most of the runoff from the northern Sierra NF is carried by the San Joaquin River to Millerton Lake at Friant Dam where it is stored and diverted, via the Central Valley Project which is operated by the Bureau of Reclamation, north through the Madera Canal and south through the Friant-Kern Canal. Water rights and entitlements delivered through the Madera and Friant-Kern Canals are extremely important to the economy of the San Joaquin Valley. For example, in 1990 nearly 850,000 acres were irrigated by the Friant diversions accounting for almost $2 billion in revenue (Bureau of Reclamation, 2013). Conversely,

recent environmental restrictions and drought have caused water shortages that have cost the San Joaquin Valley 6,000 jobs and $170 million in employee compensation (Michael 2009).

For more detailed information on key economic sectors and contributions of the Sierra NF see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1111-1282.

Fiscal Conditions

Local governments rely on revenues generated from activities on forest lands. Management decisions that affect these activities have the potential to impact these revenues. Key sources of these revenues are: (1) the sales taxes generated from timber sales and tourism and (2) direct revenue received from the Payments In-Lieu of Taxes (PILT) and Secure Rural Schools and Community Self-Determination Act (SRS) programs.

The counties bordering the Sierra NF receive revenues from sales taxes on timber products and on temporary lodging from visitors. Available data shows that these sources of tax revenue are a small percentage of the total county revenues for the area as a whole (1.1 percent) but more than the average for the bio-region (0.5 percent), suggesting these counties are more sensitive to changes in this revenue than the bio-region as a whole. However, this revenue is a significant portion of the total revenue collected in Mariposa County (20.4 percent). Specifically, the transient lodging tax revenue is the more significant contributor of the two tax sources (California State Controller's Office 2012). While the Sierra NF contributes to travel and tourism in these counties and can influence this transient tax revenue, there are other recreational opportunities in the bio-region that drive this tourism such as other national forests and national parks. Therefore all of this revenue cannot be attributed to visitors to the Sierra NF alone. One study estimated the percentage of the county sales tax revenue that is visitor related. This includes spending on goods and services while visiting an area. This visitor spending is an important fiscal consideration for Mariposa County (61.4 percent) and a lesser factor in Madera County (8.3 percent) and Fresno County (5.3 percent)(Dean Runyan and Associates 2012).

All of the counties bordering the Sierra NF received some level of Payment in Lieu of Taxes (PILT) in fiscal year 2009: Fresno ($3 million), Mariposa ($1.2 million) and Madera ($1.1 million). These values alone do not reflect the importance of these revenues to individual county budgets. Instead, looking at these PILT revenues as a percentage of total county revenues shows the importance of this contribution. For Fresno and Madera Counties, this percentage is small (0.7 percent or less). For Mariposa County (2.5 percent) this percentage is somewhat significant (Headwaters Economics 2012b).

For more detailed information on fiscal conditions see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1282-1334.

Forest Service Spending

Forest Service spending on the Sierra NF has increased from $11 million in 2006 to $20 million in 2012, mostly as a result of budget increases for wildland fire management (USFS 2012b). Total federal spending in the counties bordering the Sierra NF was a very small percentage of the approximately $5.9 billion in total federal government expenditures in these counties in FY 2006, and was an even smaller percentage of the total economic output across all sectors of the economy over this time period (California Department of Finance 2009).

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The history and changes of the Sierra Nevada create a complex environment for Forest Service management. Maintaining a cultural legacy is important to communities. At the same time, community well-being depends on the ability of those communities to adapt to a changing, uncertain future. Individuals and communities far beyond the Sierra Nevada influence the sustainability of forests and communities in the bio-region, and are likewise influenced by management decisions that take place on National Forest System land in the bio-region. There is now a much richer understanding of the social, economic, and ecological factors in land management decisions. While challenging, this complexity highlights the many opportunities the Forest Service has to contribute to social, economic, and ecological sustainability.

Socioeconomic factors important to this sustainability are:

- community capacity
- ecological restoration
- working together
- sustainable recreation
- connecting people to nature

People who live in rural communities in the Sierra Nevada are concerned about their future. Many traditionally resource-based communities in the Sierra Nevada are in a transition period. New people have moved in from urban areas, bringing different values and changing the demographics of communities. Ecological concerns, federal policies, and competing land uses have influenced timber harvesting and grazing. Outdoor recreation and tourism have brought new economic opportunities to communities that were formerly timber-dependent. Population growth, increased demand for recreation, competition for different uses, and ecological concerns bring with them additional challenges. In addition, tribal communities continue to struggle with maintaining a culture that is directly tied to management of and access to ancestral lands and sacred sites. Many people who live outside the Sierra Nevada are also dependent on the bio-region's ecosystem services, which can impact Sierra Nevada forests and local communities.

Community capacity is critical to well-being in forest communities, and can be defined as the ability of its residents to respond to internal and external stresses, create and take advantage of opportunities, and meet the needs of residents (Kusel 2001). This capacity influences the ability of communities to prepare for and adapt to change and stressors such as wildland fire and climate change (Charnley 2013).

The Sierra NF is actively engaged in building community capacity through ongoing efforts, including the Willow Creek Planning Collaborative, Dinkey Collaborative, Stewards of the Sierra, Sierra Vista National Scenic Byway group, Foundation for Resource Conservation, and Sheriff's Volunteer Patrol. Potential barriers to increasing these types of efforts include: finding qualified individuals who can provide structure and support for project coordination; a lack of staffing to supervise community resource restoration activities; appropriate partner funds; the capacity to convene; and authority.

For more detailed information on the role of community capacity see the July 2, 20313 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1368-1411.

Ecological Restoration

Management of National Forest System lands in the Sierra Nevada can contribute to community capacity by helping people become stewards of the land as participants in ecological restoration activities (Charnley 2013). This engagement is empowering because people personally partner with land management agencies to find solutions (Charnley 2013).

Healthy forests and healthy communities are interdependent, and ecological restoration not only helps improve ecological conditions, but also offers positive outcomes for individuals and communities (Charnley 2013). Ecological restoration connects people to the land and to each other, helping communities build collective identities tied to land stewardship (Charnley 2013). Stewardship contracting is thought to be an effective tool for enhancing social and economic benefits to local communities (Charnley 2013).

Current policy for national forest management calls for approaches that accomplish ecological restoration goals, while simultaneously producing forest products that can benefit local communities (USDA 2010, USFS 2007). Ecological restoration as a policy in the bio-region can contribute to reducing current trends in fire while simultaneously contributing to the sustainability of local community wellbeing. Specifically, restoration projects that support the local wood product economy also provide the opportunity to support local residents in rural areas who rely on the forest for their livelihoods. For example, one study has estimated that 13 to 29 jobs are created or retained and over $2.1 million in total economic activity is generated for every $1 million that is invested on restoration (Moseley and Nielsen-Pincus 2009). In addition, rural communities in the wildland urban interface (WUI) are economically connected with key forest sectors as they rely on activity in timber, mining, grazing and recreation. A reduction in uncharacteristic wildfire as a result of restoration reduces the potential for damage to the resources on which these forest sectors are dependent. Therefore, restoration reduces the potential for disruption on the livelihood for many of the residents in these communities (Zybach et al. 2009).

Just as restoration provides potential benefit to these rural communities, economically healthy local communities also benefit Forest Service restoration goals. Given the desire to increase the pace and scale of restoration, maintaining a robust local workforce and local infrastructure is necessary to support the logistics and economics of restoration (Charnley and Long 2013, Charnley et al. in press). This is because the revenue that can be generated through stable local markets for timber and non-timber biomass from restoration activities can help offset the costs of Forest Service restoration goals. In addition, the further the haul distance from the harvest site to the processing facility, the higher the transportation costs and less economical the timber sale. Therefore, maintaining local wood processing infrastructure in the bio-region is an important strategy for maintaining favorable economics for accomplishing ecological restoration goals while sustaining jobs in the local wood products industry (Charnley and Long 2013, Charnley et al. in press).

For more detailed information on the role of ecological restoration see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1412-1458.

Working Together

As the Chief of the Forest Service described in a January 2010 speech, in order to restore the resilience of America's forests and grasslands to disturbances of all kinds, we need to work at a scale that supersedes ownerships. Specifically:

> An all-lands approach brings landowners and stakeholders together across boundaries to decide on common goals for the landscapes they share. It brings them together to achieve long term outcomes. Our collective responsibility is to work through landscape-scale conservation to meet public expectations for all the services people get from forests and grasslands (Tidwell 2010).

Charnley (2013, p.15) found:

> A number of researchers have found that when the Forest Service works collaboratively with local communities to develop forest restoration projects that build on local community infrastructure, resources, values, culture, and collaborative relationships and address local needs and priorities, it can be especially effective in creating local community benefits and contributing to community resilience. It is not always easy to collaborate, given declines in agency staffing and resources, and there can be challenges in the process. Nevertheless, when opportunities exist to develop projects collaboratively and align them with community needs and capacity, they are more likely to create local community benefits.

For more detailed information on the role of working together see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1459-1492.

Sustainable Recreation

Outdoor recreation is a major part of the culture and lifestyle in the Sierra Nevada, and in California in general. The social, economic, and ecological benefits are numerous. Outdoor recreation contributes to people's connection to nature, sense of place, and community identity. It provides physical and mental health benefits, and a foundation for stewardship. Recreation supports social interactions with friends and family, which is especially important in the Latino community. There is growing recognition of the importance that recreation volunteerism plays in maintaining the quality of opportunities throughout California, as well as in restoring ecosystems. Recreation is an important part of California's tourism portfolio. Population growth and resulting increases in recreation and tourism have brought new economic opportunities to many Sierra Nevada communities. The greatest economic activity the Forest Service generates is through recreation special uses.

Recreation activities in the Sierra Nevada, compounded by various stressors to the system, can also have negative impacts on social, economic, and ecological conditions. Recreation on National Forest System lands can increase the spread of invasive species. Unmanaged recreation can adversely impact natural resources. Manipulation of streams for water recreation has degraded watersheds. Population growth has led to increased competition for water among various uses. Increasing numbers of outdoor recreationists can lead to increased conflict, and a lesser quality of experience. Recreation and tourism have led to an influx of urbanites into Sierra Nevada communities, which can increase the cost of living, and result in shifting values.

The Forest Service Framework for Sustainable Recreation provides focus areas that help national forests contribute by shaping the role of recreation in promoting forest and grassland health and strengthening the vitality of our communities (USFS 2010).

Connecting People

The economy relies on society, and society is dependent on the environment. This is the general premise of the Millennium Ecosystem Assessment (2005), which recognized the growing burden degraded ecosystems are placing on human well-being and economic development. It points out that sustaining the benefits ecosystems provide for human well-being requires a full understanding and wise management of the relationships between human activities, ecosystem change, and well-being in the near and long term future.

The importance of the connection between people and Sierra Nevada forests is clear. Many people outside the Sierra Nevada feel a deep connection with the forests in the bio-region. It is important to continue to foster these connections. At the same time, many people who benefit from resources originating in the forest, such as water and electrical power, may not be aware of these benefits and may never visit (USFS 2012a). Opportunities exist for developing connections where they do not yet occur, especially in many urban communities, where water demand, resource demand, and pollution all influence the health of Sierra Nevada ecosystems. Ecosystem services can be a useful framework for forest stewardship (Smith et al. 2011) by helping stakeholders identify and understand services provided by a landscape, and human use and dependence on those services.

Another important piece of connecting people to Sierra Nevada forests is the major change in ethnic composition occurring within and just outside the Sierra Nevada, as well as the country as a whole.

> Increased cultural diversity in California will continue to be reflected through immigration of Latinos and Asians into Sierra Nevada communities, thus increasing the importance of attending to cultural influences and values of long-standing and newly immigrated residents. These dimensions of diversity add to the already diverse demographic, economic, and ethnic profile of Sierra Nevada communities. Both new and existing populations will challenge modes of outreach, engagement, and approaches to management. Particular attention will need to be paid to groups who may be underserved or underrepresented in opportunities to have their opinions heard, needs or interests represented in decisions about how places will be managed, and opportunities to use their public lands (Winter et al. 2013b, p.8).

For more detailed information on the role of connecting people see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1522-1597.

Information Gaps

While providing readily available information, some limitations exist to using U.S. Census Bureau – American Community Survey (ACS) data to describe local demographics. ACS data provide estimates that describe the average characteristics of population and housing from 2006 to 2010 and cannot be used to describe any particular year during that period. The ACS uses samples to estimate demographic data for the entire population of interest and is subject to error. Less populated areas, such as gateway

communities and some CCDs, tend to have lower accuracy than at larger scales. As noted earlier, some communities were too small to be included in the ACS.

Social and cultural data specific to the Sierra NF is fairly limited. National Visitor Use Monitoring (NVUM) data provide the most relevant, reliable, and accurate data specific to Sierra NF visitation. While more recent NVUM data were collected in fiscal year (FY) 2012, they are currently being processed, and only FY 2007 data were available at the time of writing. While NVUM provides useful information on those already visiting the Forest, it does not provide any insight into those people who do not use the Forest and why. Also, while there is general or state-level information regarding the importance of national forests, other public lands, and outdoor experiences on human and community well-being, little information specific to the Sierra NF is available. It would be helpful to have information regarding the importance of other motivations for visiting the Forest beyond activities listed in NVUM, such as spending time with friends and family, physical and mental health benefits, and connecting with culture and history.

Economic data is not available at the local community level to identify the specific context of condition and trend for economic health, economic diversity and forest sector activity. Currently, this information is presented at the county and sub-county (Census CCD) level where available. Going forward during the collaboration phase, it will be useful to collect any data local governments and organizations may have to describe these more local economic conditions. Also, where data is not available, qualitative information would be useful to help describe local context and characteristics. Another current gap in economic information is detailed information on direct forest spending in local economies (i.e. how much of spending goes to local businesses as opposed to businesses located outside of these local communities). This is important to accurately identify the impacts of this spending and its importance to local job creation and wages.

Another information gap from an economic perspective is data that can be used to prioritize the benefits to people from ecosystem services so that tradeoffs, both short term and long term, can be evaluated, compared and contrasted. Ecosystem services are the benefits that people obtain from ecosystems and therefore these services have a value to everyone. Because these values are often difficult to quantify, impacts on these services can be neglected during forest planning. The term “value“ is used here to represent something more inclusive than a monetary or dollar value but rather to capture the idea that benefits, even when they are not directly relatable to dollars spent or received, are still able to contribute to improving the quality of people’s lives. Examples of these types of non-monetary benefits are provided by key ecosystem services such as cultural heritage and biodiversity. In contrast, examples of key services that are tied to existing markets and therefore can be more directly related to monetary value are recreation, timber and water. More detail on this topic can be found in Chapter 7 of this assessment.

Chapter 7: Benefits to People

The Sierra NF provides many benefits to people. The forest has many high elevation lakes, towering conifers, deeply carved river valleys and beautiful mountains. These landscapes are home to for many recreational activities that visitors expect and enjoy. The Sierra NF is the origin of the headwaters of the San Joaquin, Kings, and Merced Rivers that sustain the population and the agricultural industry of the San Joaquin Valley.

Ecosystem services such as recreation and water are enjoyed directly by individuals and communities and as a result, their contribution to our well-being is more easily understood. Other vital ecosystem services provide benefits that are less apparent in our daily lives but are important because they support and regulate the ecosystems in which people live (e.g. cultural heritage, carbon sequestration and biodiversity). Consideration of ecosystem services should include benefits from all of these services. Therefore, the consideration of ecosystem services ensures that the complete value of forests is incorporated into the adaptive management planning process and for the future.

Important Information Evaluated in this Phase

This assessment identifies and examines seven key ecosystem services provided by forests across the bio-region:

- water supply
- hydropower
- timber
- carbon
- recreation
- cultural resources
- biodiversity

These key ecosystem services were chosen because: (1) they are a subset of the services that were examined for the bio-region as a whole and determined to require a consistent approach to management across forest boundaries; (2) they have been identified as important to people in broader landscape as people enjoy these services on the forest, and communities surrounding the forest benefit from these services; and (3) they are likely to be affected by the plan alternatives.

The condition and trend of these ecosystem services are dependent on the underlying resources that support them. Therefore, the information for this chapter relies on the specific resource assessments that were conducted in the other chapters of this assessment.

Nature, Extent and Role of Existing Conditions and Future Trends

This section examines the nature, extent and role of existing conditions and future trends for the key ecosystem services of the Sierra NF.

Water

Water is important for use, hydropower and to support recreational opportunities. More information on the current conditions and trends for water can be found in Chapters 2 and 8 of this assessment.

Geographic Scale of Service

The benefits of water supply and water quality are both local and regional in scale. Local benefits include clean water that supports ecosystems that provide services on forest lands, such as water recreation and fishing. In addition, this water supports the terrestrial and aquatic plant and animal species that make for a

resilient and healthy forest ecosystem. Regional benefits include water that is supplied for urban and agricultural uses throughout the Central Valley and Southern California, as well as the electricity produced from hydropower.

Condition and Trend of Service

The condition and trend of the key ecosystem services for water examined here are water supply, hydropower and water recreation. More information on these topics can be found in Chapters 8, 9 and 10 of this assessment.

Hydropower

There are 13 licensed hydropower projects on the Sierra NF. These projects have created approximately 21 impoundments on the San Joaquin and Kings River drainages, and have at least 60 developed recreation sites associated with them. At the same time, other recreation activities have been negatively impacted by hydropower development, such as whitewater rafting. Although hydropower emits little or no pollution when generating electricity, it can have environmental impacts. Reservoirs, dams, turbines and other infrastructure may affect the fish, wildlife and vegetation in and around the hydro plant.

Water Recreation

The Forest contains 1,800 miles of streams and rivers, and 480 inventoried lakes. Along the lakeshores of the Sierra NF there are day and overnight public recreation facilities, and use of forest land by several resorts, recreation residences, and organizational camps. The lake's northeastern shores are characterized by residential homes, several resorts, and relatively steep shoreline terrain managed as open space by the Forest Service. Local Bass Lake Chamber of Commerce, the Huntington Lake Association private resorts, Madera County Visitors Bureau, and the Forest Service actively promote the attractions found at Sierra NF lakes.

Drivers Affecting Demand and Availability

Climatic predictions for California include increased warming, smaller snowpack, and earlier spring snowmelt. These changes would influence the amount of water supply that can originate from forest lands through reduced precipitation, as well as the amount and types of vegetation on forest lands that influence the timing of water supply. Climate change is also expected to increase the potential severity and area of fire events, which also impact the conditions that influence the timing of water supply.

For more detailed information on water as an ecosystem service see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 76-140.

Timber

More information on the current conditions and trends for timber can be found in Chapter 8 of this assessment.

Geographic Scale of Service

Timber is important to the local ecology in terms of the benefits of restoration activities, and to local economies in terms of the job opportunities and economic activity that is generated. There is also a larger scale benefit in terms of the timber products produced.

Condition and Trend of Service

The five year (2008-20120) rolling average timber volume sold on the Sierra NF is 12,510 million board feet (mbf). The forest has been managing a planned sell volume for the last three years of 16,000 mbf annually, as indicated in the expected potential outputs projected from the Land and Resource Management Plan (LRMP) Forest Plan Amendment 2004.

Currently the Sierra NF is providing timber for three remaining sawmills. These are Sierra Forest Products in Terra Bella, California, Sierra Pacific Industry in Chinese Camp, California and Sierra Pacific Industries in Standard, California. The Sierra Forest Products mill is the last remaining mill in California south of Yosemite. Sierra Forest Products also operates a wood-fired electrical power plant co-located with its mill. Sierra Forest Products is considered a small business and Sierra Pacific Industries is considered a large business in computations for Small Business Administration market share monitoring purposes.

Timber under contract on the Sierra NF has declined over the last 25 years. Volume under contract was severely depleted in the boom years of the late 1980s, recovered somewhat in the early 1990's, then declined, mostly in response to the requirements of the Sierra Nevada Forest Plan Amendment (SNFPA) of 2001 and 2004.

Drivers Affecting Demand and Availability

From 2000 to 2011 on national forests in California, the Forest Service experienced wildfire on 2,654,000 acres (on fires larger than 1000 acres). Of this, 1,601,000 acres, or 60 percent of the burned area, was productive forest growing trees. Of this, 370,000 acres were deforested by fire outside of designated wilderness. This destruction of inventory is approximately 4 percent of total available productive national forests in California. In addition, the Sierra NF has experienced greatly elevated and epidemic infestations of western pine beetle over the last five years.

While the mixed conifer vegetation type is only a portion of the landscape on the Forest, these stands require significant management attention. Their location, the current condition of the species composition, fuel loading, and tree age and size differ dramatically from the historical condition. The trend to rapidly grow to overstocked conditions from the recent historical stand development of modern accretions of young shade tolerant and less fire-resistant tree species puts them in jeopardy from fire and insect and disease mortality elements.

For more detailed information on timber as an ecosystem service see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 141-193.

Carbon

More information on the current conditions and trends for carbon can be found in Chapter 4 of this assessment.

Geographic Scale of Service

Forests play an essential role in global carbon storage, by removing carbon dioxide (CO_2) from the atmosphere and by storing carbon as biomass within ecosystems. Increases in atmospheric CO_2 over the last century have been linked to rising temperatures, and because forests absorb CO_2, they play an important role in regulating climate.

Condition and Trend of Service

Estimates have been calculated for the carbon sequestered in the forestlands of the Sierra NF. Forestlands are defined here as being composed of at least 10 percent cover by live trees of any size, including land that formerly had such tree cover and that will naturally or artificially be regenerated (Smith et al. 2005). The Sierra NF has the third highest forest carbon density in the bio-region after the Eldorado and Plumas National Forests. Other important landscapes contributing to carbon sequestration are shrublands and meadows. There are no Sierra NF specific estimates for carbon in these landscapes but studies have been done to show that these are important areas for sequestration (Meyer 2012, Norton et. al. 2006, Janzen 2004).

Drivers affecting Demand and Availability

Looking at trends in carbon sequestration, a Forest Service study conducted an assessment of carbon sequestration capabilities of the national forests in California over the next 100 years (USFS 2009). The assessment analyzed forest growth, disturbance, and management options under a range of management scenarios for national forests in California. The analysis concluded that under current forest management activities, over the next four to six decades, California national forests will accumulate carbon at a higher rate than carbon will be lost, although at a decreasing rate because of increased carbon loss through disturbances such as wildfire, insect and disease related pest mortality and inter-tree competition. However, at some point in the mid-21st century, carbon losses from wildfire, disease and other disturbances will exceed growth and national forests in California will become net emitters of carbon.

For more detailed information on carbon sequestration as an ecosystem service see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 194-236.

Recreation

More information on the current conditions and trends for recreation can be found in Chapter 9 of this assessment.

Geographic Scale of Service

Recreational opportunities on the Sierra NF attract visitors and provide benefits to people from neighboring counties, around the state, across the country and internationally. These benefits include the contributions to local economies that are provided by these visitors.

Condition and Trend of Service

The Sierra NF is a recreation destination forest. Close to 50 percent of visitors travel 200 miles to be able to recreate here (USFS 2003). The Sierra NF is a destination for recreation, from camping to picnicking to enjoying the wilderness. These opportunities provide destinations for visitors to escape from the heat and routine urban life, and to connect with nature, family and friends. The 2003 Sierra NF National Visitor

Use Monitoring (NVUM) report showed that 43.2 percent of those who visited the forest did so to relax, 41.2 percent walked or hiked, 22.8 percent went fishing, 1.3 percent went hunting, and of those contacted during the monitoring, 4 percent participated in motorized activities, like off-road driving (USFS 2003). The Sierra NF 2008 NVUM report showed an increase in visitors traveling to the forest to relax at 48.7 percent. All other dispersed recreation activities showed a 1 percent decrease from the previous survey (USFS 2008).

The Sierra NF provides a diversity of recreation opportunities to local rural residents, nearby communities and towns, and urban areas along the California coastline. Facilities offer opportunities that range from highly developed campgrounds and picnic areas, to minimally developed overnight and day use areas that serve primarily as access points to trails, creeks, rivers and general forest areas. The Sierra NF provides tremendous opportunities for hiking, horseback riding, mountain biking as well as off road vehicle use on trails jointly maintained by the Forest Service and a variety of partners.

Drivers affecting Demand and Availability

Most visitors to the Forests use some type of recreation facility. Therefore, traditions, ability to travel to a destination, available amenities, and access to water are important for a satisfactory recreation visit. Access to wilderness, high mountain lakes and reservoirs, and out of the way places to visit are, for the most part, driven by the economics of the visitor.

Because both Fresno and Madera Counties were projected to have substantial growth in the next 20 years, the number of people participating in recreational activities may be expected to increase. However, factors such as economic conditions and gas prices can heavily influence growth rates and the number of people participating in recreational activities. The factors can lead to increases or decreases in growth rates and participation in recreational activities (California State Parks 2010).

For more detailed information on recreation as an ecosystem service see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 237-303.

Cultural Resources

More information on the current conditions and trends for cultural resources can be found in Chapters 12 and 13 of this assessment.

Geographic Scale of Service

The Sierra NF provides the benefits of cultural and historic resources that expand the knowledge and understanding of history, maintain cultural and spiritual connections to our heritage, provide scientific data about past cultures and climatic conditions, and generate tourism that benefits rural economies. The beneficiaries of these cultural and historic resources are Native American, European, Asian, and African American peoples located throughout the state and the country.

Condition and Trend of Service

The Sierra NF has 4,291 cultural resources that it manages. Of these 3,323 are prehistoric resources and the overwhelming majority of all resources, accounting for approximately 78 percent of the total. These resources include traditional cultural properties, traditional gathering areas, spiritual places, traditional trails, historic districts, and cultural landscapes. Ninety-five percent of all cultural resources on the forest

have not been formally evaluated for National Registry of Historic Places (NRHP) eligibility. Two hundred and forty-one sites and districts have been formally evaluated. Of those, 110 have been determined to be eligible and 131 have been determined to be ineligible for listing. The forest currently has one listed property, and two additional properties are under evaluation and review.

The existing condition of the resource affects its significance under the law, its listing on the NRHP, and identifies what actions need to occur in order to maintain, protect, and interpret it. On the Sierra NF, of the 4,291 resources, disturbances have been observed on 583. No disturbances have been observed on the remaining 3,715.

Drivers affecting Demand and Availability

There are six overarching trends driving change over the next 10-20 years and beyond. These trends include a warming climate, a growing population, a decreasing federal budget, an increasing demand by California Native American tribes for access to and use of traditional and sacred cultural resources and places, an increasing interest by the public in their heritage and a consequent demand for heritage tourism, and a decline in the economic viability of rural America.

For more detailed information on cultural resources as an ecosystem service see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 304-358.

Biodiversity

More information on the current conditions and trends for biodiversity can be found in Chapter 1 of this assessment.

Geographic Scale of Service

Biodiversity provides benefit to people as described in the Convention on Biodiversity co-authored by the Forest Service (Thompson et al. 2009):

> The best available scientific evidence strongly supports the conclusion that the capacity of forests to resist change, or to recover from disturbance, is dependent on biodiversity at multiple scales.

In addition, biodiversity also provides some direct service to people through the value that can be placed on meeting an ethical obligation to protect other species from extinction, supporting religious and cultural values associated with cherishing the Earth and its inhabitants, and the desire to leave for future generations that which we are able to enjoy (EPA 1999).

Condition and Trend of Service

Extreme elevation changes provide diverse vegetation from grasslands to sub-alpine meadows. The Ponderosa pine is the predominant tree species in this forest and can be found between the 4,000 and 8,000 foot elevations. The Sierra NF also provides suitable habitat for about 315 wildlife species and 31 fish species. The Sierra NF is one of three native sites for the Pacific Fisher, a threatened species, whose original range included much of the western United States and Canada. Broad-scale habitats on the Sierra NF remained relatively stable between 2001 and 2010. The management framework during this period also reflects this habitat stability, which has focused on forest sustainability, thinning smaller trees and

retaining and growing larger trees. There are some increasing and decreasing trends that are of concern with respect to fire, climate change and natural succession.

Drivers affecting Demand and Availability

Disturbances have occurred for millennia, and plant species and communities have evolved and adapted to them over time. Disturbances perform important functions within the Sierran ecosystem, such as insect outbreaks that modify species composition and structure by thinning individual trees and creating openings. However, major drivers and stressors of ecosystems can also be abnormal outside the historical range of ecosystem variability, potentially resulting in severe disruptions to ecosystems. The most widespread and influential drivers and stressors affecting biodiversity are fire, climate change, invasive species, development, and land use management.

For more detailed information on biodiversity as an ecosystem service see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 359-410.

Uncharacteristic Fire and Implications on the Conditions and Future Trends of Key Ecosystem Services

The continued enjoyment of the benefits obtained from forest ecosystem services is vulnerable to the threat of uncharacteristic fire. Wildfires are becoming larger, more frequent and of greater severity. These fires threaten the health of the resources in the forests that support ecosystem services. Any resulting interruption or loss of these services has a cost, as these ecosystem services provide benefits both locally to forest users and rural communities, as well as regionally in the form of the water, energy, carbon sequestration, and cultural services to people all over California.

To get a sense of the extent to which fire threatens the many important services provided by the Sierra NF, the landscapes that provide these services were examined for their risk for uncharacteristic fire that would be detrimental to these services. It is clear that a high percentage of these landscapes are under a threat from uncharacteristic fire.

Specifically:

- 62 percent of the land with the most valuable assets for protecting water quality is at risk for uncharacteristic fire
- 61 percent of the land with the most valuable assets for supporting water supply is at risk for uncharacteristic fire;
- 67 percent of existing hydroelectric facilities
- 98 percent of the important timber producing land is at risk for uncharacteristic fire
- 65 percent of the important carbon sequestration land is at risk for uncharacteristic fire
- 82 percent of Forest Service recreation facilities is at risk for uncharacteristic fire
- 82 percent of the locations that provide habitat for important ethno-botanical species for cultural heritage uses are at risk for uncharacteristic fire
- 45 percent of the land important to providing terrestrial biodiversity is at risk for uncharacteristic fire
- 84 percent of the land important to providing aquatic biodiversity is at risk for uncharacteristic fire

The fact that such a large extent of the forest's landscape that provides these key services is at risk suggests that under current conditions, the trend will be for increased loss and interruptions in the benefits that these services provide. Contributing to this potential trend in declining benefits to people is the fact that the cost of fire management which includes fuel reduction and fire preparedness, and suppression have made up a larger and larger portion of forest budgets. Limited budgets for management mean that an increase in fire spending reduces the forest's ability of to take care of other management needs that also threaten the sustainability of these services.

More details on the effect of fire on ecosystem services across the bio-region and the methodologies used in this analysis are available in Chapter 7 of the Bio-Regional Living Assessment.

Contributions the Plan Area makes to Ecological, Social or Economic Sustainability

This section examines the stability and resiliency of key ecosystem services on the Sierra NF and influences outside of the forest.

Water

Stability and Resiliency of the Ecosystem Service

Two Hydrologic Unit Code (HUC) six watersheds on the Sierra NF have been designated "priority" for restoration purposes. These are the South Fork Willow Creek in Madera County and the Upper Big Creek in Fresno County. Watershed restoration action plans have been prepared for these watersheds.

Influences on the Service outside of Plan Area

Most of the runoff from the northern Sierra NF is carried by the San Joaquin River to Millerton Lake at Friant Dam, where it is stored and diverted, via the Central Valley Project which is operated by the Bureau of Reclamation, north through the Madera Canal and south through the Friant-Kern Canal. Water rights and entitlements delivered through the Madera and Friant-Kern canals are extremely important to the economy of the San Joaquin Valley. For example, in 1990, nearly 850,000 acres were irrigated by the Friant diversions, which accounted for almost $2 billion in revenue (Bureau of Reclamation, 2013). Conversely, recent environmental restrictions and drought have caused water shortages that have cost the San Joaquin Valley 6,000 jobs and $170 million in employee compensation (Michael 2009).

On the south side of the Sierra NF, most runoff eventually drains to the Kings River and is stored in Pine Flat Reservoir. Pine Flat Dam is operated by the U.S. Army Corps of Engineers (USACE). Water entitlements and deliveries are overseen by the Kings River Water Association (KRWA), which consists of 28 public agencies that provide irrigation water to nearly 20,000 farms in Fresno, Kings, and Tulare counties. The KRWA works closely with the Kings River Conservation District (KRCD), a public agency that deals with flood control, hydroelectric power, water management, and groundwater development. The KRCD has no actual water entitlements.

Federal land reservations for tribes have an associated reserved federal water right. Tribes within or near the Sierra NF include: Big Sandy Rancheria of Western Mono Indians of California, North Fork Rancheria of Mono Indians, Picayune Rancheria of Chukchansi Indians of California, and Table Mountain Rancheria of California.

For more detailed information on the contribution of water to sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 449-498.

Timber

Stability and Resiliency of the Ecosystem Service

The current Land and Resource Management Plan estimated a sustainable production level of approximately 16 mbf on average per year, for the Sierra NF. Industry representatives inform us that approximately 25,000 mbf will be needed from the Sierra and Sequoia National Forests for the last remaining local sawmill infrastructure south of Yosemite National Park. One shift of 130 employees at that that mill requires approximately 30,000 Mbf annually.

Current policy for national forest management calls for approaches that accomplish ecological restoration goals, while simultaneously producing forest products that can benefit local communities (USDA 2010, USFS 2007). Ecological restoration as a policy in the bio-region can contribute to reducing current trends in fire while simultaneously contributing to the sustainability of local community wellbeing. Specifically, restoration projects that support the local wood product economy also support local residents in rural areas who rely on the forest for their livelihoods. For example, one study has estimated that 13-29 jobs are created or retained and over $2.1 million in total economic activity is generated for every $1 million invested on restoration (Moseley and Nielsen-Pincus 2009). In addition, rural communities in the wildland urban interface (WUI) are economically connected with key forest sectors as they rely on timber, mining, grazing and recreation activity. A reduction in uncharacteristic wildfire as a result of restoration reduces the potential for damage to the resources on which these forest sectors are dependent. Therefore, restoration reduces the potential for disruption on the livelihood for many of the residents in these communities (Zybach et al. 2009).

Influences on the Service outside of Plan Area

The ability of the timber industry to respond to probable increased volume opportunity and production varies depending on milling infrastructure, logging infrastructure, and product transportation. The milling infrastructure available is currently under-utilized and may be subject to failure under current government timber production plans. If the infrastructure survives in the short term, mills have the capacity to double and maybe triple output if the supply is made available.

For more detailed information on the contribution of timber to sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 499-531.

Carbon

Stability and Resiliency of the Ecosystem Service

Climate change that affects the growth of vegetation will impact the amount of carbon stored in the forest. Much of the carbon now accumulating in these forests is in the form of ladder fuels, which carry fire from the lower vegetation canopy to the upper canopy of trees. As mean fire size and burn severity has increased with vegetation changes, fire has played an increasingly important role in carbon storage (North 2013). Grazing also influences the carbon storage of ecosystems through forage removal, hoof action and

activity that effects soil and livestock waste. Insect and disease outbreaks can convert forests from carbon sinks to sources (Kurz et al. 2008, Pfeifer et al. 2011). Finally, predicted increases in the population of California will have an influence on carbon storage and sequestration in the assessment area.

Influences on the Service outside of Plan Area

The 2006 Global Warming Solutions Act (CA Assembly Bill AB 32) requires California to reduce greenhouse gas emissions to 1990 levels by 2020, and to identify the most feasible and cost-effective methods to reduce emissions. The reductions may be achieved through a variety of methods, including capping greenhouse emitting sectors such as manufacturing, energy production, transportation, and issuing emission allowances that will achieve these greenhouse gas reductions.

For more detailed information on the contribution of carbon sequestration to sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 532-558.

Recreation

Stability and Resiliency of Ecosystem Service

Visits to the bio-region for all types of recreating experience play a key role in stimulating local employment by providing opportunities and goods and services for these recreation activities. Communities benefit economically from these visitors who spend money in hotels, restaurants, resorts, and gift shops and who contribute to sales tax revenues. As a result, travel and tourism sustains local economies near these abundant recreational areas.

Declining federal budgets could result in a declining quality of condition for existing facilities, resulting in a lower quality of experience. Budget limitations also hinder the ability of the Forest Service to expand recreation in response to people looking for more and different types of opportunities.

Influences on Service Outside of Plan Area

The Yosemite and Sequoia National Parks provide high-quality scenery and recreation opportunities outside the forest boundary, as do city, county and state parks. So while the Sierra NF does contribute to travel and tourism in the area, and therefore can influence, there are other recreational opportunities in the area that also drive this tourism. Therefore this economic opportunity cannot be attributed only to visitors to the Sierra NF.

For more detailed information on the contribution of recreation to sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 559-579.

Cultural Resources

Stability and Resiliency of Ecosystem Service

It is difficult to identify future stability and resiliency of this service. For example, with increasing wildfire threat, current management direction to avoid cultural resources during fuels treatments and timber removal activities has led to some unexpected adverse results. Namely, the Sierra NF, in an effort to avoid impacting cultural resources, has excluded archaeological sites from fuels and vegetation

treatments for approximately 30 years. As a result, there is unnaturally dense vegetation growth on archaeological sites in the forest. The vegetation has grown unchecked on the sites, while the surrounding area has been treated. This concentrates the fuels on these cultural resources.

Influences on Service outside of Plan Area

For decades the Sierra NF has had an exemplary relationship with the local Native Californian tribal governments and community. The forest holds regular information sharing and consultation meetings, as well as having an "open door" policy to the tribes to share issues and concerns. Tribal people actively gather traditional resources, conduct religious ceremonies, and consult with the Sierra NF on activities and projects. In support of traditional gathering activities and religious practices, the forest annually issues hundreds of tribal gathering cards, and has for many years issued special uses permits for the bi-annual Haslett Basin Bear Dance, and the annual Mono Trail Walk. Based on local, regional, and national interest in traditional aboriginal land use by Native Americans, it is projected that Native Californian traditional use of Sierra NF lands will intensify over the next decade or two.

For more detailed information on the contribution of cultural resources to sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 580-622.

Biodiversity

Stability and Resiliency of Ecosystem Service

Broad-scale habitats are generally expected to remain relatively stable over the next 20 years, assuming current management and considering the relatively slow progression of natural succession. This assumes that the pace and scale of forest treatments, fire suppression, and wildfires remain similar to current levels.

Information Gaps

Key information gaps for ecosystem services exist for the value of these services. Going forward it will be important to begin to identify ways to prioritize the benefits to people from these services so that tradeoffs can be evaluated.

Ecosystem services are the benefits that people obtain from ecosystems. Therefore, these services have a value to everyone. Because these values are often difficult to quantify, impacts on these services are sometimes be neglected during forest planning. "Value" means something more inclusive than a monetary or dollar value here. It captures the idea that benefits, even when they are not directly relatable to dollars spent or received, still improve the quality of people's lives. Key ecosystem services like cultural heritage and biodiversity are examples of non-monetary benefits. In contrast, examples of key services tied to existing markets and that can be related to monetary value are recreation, timber and water.

As a result of this mix of monetary and non-monetary benefits, estimating a value of the ecosystem services provided by a forest can be a complicated endeavor. It needs to be approached on a case-by-case basis, because benefits differ depending on the service being examined, the location of that service and the users of that service. For example, the same service may be provided in two locations but in one location there are few users and many alternative sources of that service, and in the other there are many users and no easy alternatives. In addition, an effort to calculate a value can require a considerable

amount of time and money to accomplish. It is not the intention in this section to present complete values for the key ecosystem services of the Sierra NF. However, it is possible to start to understand the potential value of these key ecosystem services by looking at the extent of the benefits they provide.

For more detailed information on the value of these ecosystem services see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 7, lines 631-755.

Chapter 8: Multiple Uses – Water

Information on the current conditions and trends for aquatic and riparian ecosystems can be found in Chapter 1 and 2 of this assessment. Information on water quantity and quality can be found in Chapter 2 of this assessment. The economic importance of water can be found in Chapters 6 and 7 of this assessment. Information on hydropower can be found in Chapters 7 and 10 of this assessment. Information on Wild and Scenic Rivers can be found in Chapter 15 of this assessment.

Chapter 8: Multiple Uses - Fish, Plants and Wildlife

The Sierra NF encompasses approximately 1.3 million acres, with about 42 percent, or 528,000 acres designated as wilderness. As described in Chapter 1 of this assessment, the elevation span of over 12,000 feet, combined with the variability in aspect and slope created by three deep river canyons, a variety of geology and soils, and precipitation primarily in rain at low elevations and snow at high elevations, combine to create a high diversity of ecosystems across the forest. Indeed, the Sierra NF is inhabited by over 1400 taxa (species, subspecies, varieties) of vascular plants, about 300 species of bryophytes (mosses, hornworts, and liverworts), hundreds of species each of lichens and fungi and approximately 346 species of fish and wildlife: 31 fish species, 13 amphibian species, 198 bird species, 82 mammal species and 22 reptile species. The presence of a variety of vegetation, wildlife and aquatic species in ecosystems that are visited by the public, provides many opportunities for passive and spiritual recreation through nature watching, as well as active and direct connections through fishing, hunting, plant gathering and viewing.

Important Information Evaluated in this Phase

Multiple-use management of forest resources contributes a range of public benefits through ecosystem services (36 CFR 219.6(b)). These ecosystem services yield both tangible (e.g. timber, range, recreation) and less tangible (e.g. spiritual, cultural, air and water quality) benefits. The multiple-use mandate under the Multiple-use Sustained-Yield Act of 1960 (MUSYA) (16 U.S.C. 528-531) and the National Forest Management Act of 1976 (NFMA) (16 U.S.C. 1600 et seq.) is not exclusive to a single resource or use, and the sustained-yield principle applies to all multiple-use purposes for which the national forests are administered.

Each of these multiple uses is assessed by defining the species or resources, current conditions and landscape level drivers that affect those resources. Condition trends are provided when available. The scope of these assessments is commensurate with the degree of multiple use benefits to the Sierra NF plan area. Multiple uses of these resources on the Sierra NF include fishing, hunting, nature watching, and plant gathering. These are examined below.

Nature, Extent and Role of Existing Conditions and Future Trends

Fishing

Species and Conditions

There are more than 1,500 miles of stream occupied by fish species, 11 large reservoirs, and 7,500 acres of lakes distributed across the Sierra NF, providing a variety of angling opportunities for some 30 species of fish. The California Department of Fish and Wildlife (CDFW) hatchery program has been rearing and stocking fish in the inland waters of California since the late 1800s. The overall purpose of the recreational fish-stocking program is to augment trout populations where recreational angling demand is greater than natural production and other standard methods of fisheries management are insufficient to meet that demand (CDFW 2003).

Using 1984-2004 CDFW electro-shocking population data and elevation of flow unregulated streams as sorting criteria, the Sierra NF unregulated sites are generally comparable to west-slope Sierra Nevada streams. Sierra NF unregulated streams generally have more trout per mile, but fewer adult trout per mile. This may be an indicator of angling pressure or the effect of smaller streams in the forest data.

Trends

Existing condition of aquatic habitat and fisheries has been influenced by a variety of drivers. Among the findings within the Sierra Nevada Ecosystem Project was that the aquatic/riparian systems were the most altered and impaired habitats of the Sierra Nevada (Centers for Water and Wildland Resources 1996).

The Sierra NF completed a Settlement Agreement with Southern California Edison in 2008 regarding future operations of several of its hydroelectric facilities. Among the conditions on the new licenses would be increases in minimum instream flow, along with channel and riparian maintenance flows. Increases in flow would augment the amount of habitat available for trout, and possibly reduce water temperatures in some stream segments, providing additional cold water habitat. This would affect approximately 90 miles of streams when the new Federal Energy Regulatory (FERC) license is issued.

As noted under the climate change discussion, projections are that precipitation patterns may be different from current conditions. Projected increases in air temperature may reduce the amount of snow, and snow accumulations. Such changes may alter the timing, duration, and magnitude of flows. Higher winter flows may result from decreases in precipitation in the form of snow, accompanied by declines in the magnitude of spring runoff and the amount of water available as streamflow later in the summer. Such changes would increase water temperature, decreasing the amount of habitat available for cold water species.

For more detailed information on fishing see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 44-176.

Hunting

Species and Conditions

Wildlife hunting is one of many public social and economic uses on the Sierra NF. Deer, black bear, tree squirrel, wild turkey, mountain quail and California quail are the most popular hunted species within Sierra NF (CDFW 2012, Duane 1996, Kroeker 2012). Some of these species migrate outside the Sierra NF, such as sub-populations of migratory deer. Species such as wild pig, quail, and wild turkey are most common in the lower foothills below national forest boundaries, but are also common in some lower elevation foothill areas of the national forest. Currently, there are no detailed population estimates for hunted species on the Sierra NF other than for deer, although annual permit data is collected by CDFW for most hunted species (CDFW 2012).

Deer within Sierra NF are primarily within two herds: the San Joaquin Herd and the North Kings Herd. These herds primarily consist of migratory populations, with a smaller number of resident deer using the lowest elevations of the national forest year-around. The current population of these herds is estimated at about 2,000 to 3,000 animals each, with a total estimated population of about 4,000 to 6,000 for Sierra NF (Kroeker 2012, Fidler 2012). Deer hunters have some of the highest hunter participation rates and the largest total hunting expenditures for Sierra NF (CDFW 2012, Duane 1996).

Trends

Trend assessments have been developed for the San Joaquin and North Kings deer herds based on 45 years of unpublished fawn-to-doe composition counts from 1950 through 2012 (Kroeker 2012 and Fidler 2012). Composition counts for the San Joaquin herd ranged from an average high of 57 fawns to 100 does between 1954 and 1960, to an average low of 33 fawns to 100 does between 1961 and 2012. The latest ratio in 2012 was 29 fawns to 100 does. Composition counts for the North Kings herd ranged from an average high of 50 fawns to 100 does between 1954 and 1960, to an average low of 33 fawns to 100 does between 1982 and 2000. Since 1961, the fawn-to-doe ratios have consistently hovered around 33 fawns to 100 does for the North Kings herd, with the latest ratio of 28 fawns to 100 does occurring in 2012.

Creating and maintaining a sustainable level of early seral forage habitats, such as shrubs, forbs, and grasses, integrated with cover habitat, is essential for sustaining deer, as well as hundreds of other species that rely on those habitat mosaics. Edge habitats, also called eco-tones, are an important part of the historic forest and ecosystem heterogeneity that helped sustain a wide diversity of wildlife, including deer. The apparent slow, declining trend of deer populations on the Sierra NF and other national forests (Bertram 1984, Salwasser et al. 1978, Longhurst et al. 1976, Kroeker 2012) is influenced by a multitude of factors, but at a minimum, management considerations should at least consider maintaining early seral habitat of shrubs, forbs and grasses within the historical range of variability.

For more detailed information on hunting see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 223-369.

Nature Watching and Wildlife Viewing

Species

The Sierra NF has bright and colorful displays of native wildflowers that attract a wide variety of visitors. These displays begin in February and March in the foothills, and follow spring upslope all summer to the alpine zone where full bloom occurs in August. An example of one of the more well-known foothill trails that attracts wildflower enthusiasts is the Hite Cove Trail along the South Fork Merced River, where in a good rain year in March or April the hillsides can be solid orange with tufted poppies (*Eschscholtzia caespitosa*). Brilliant pink redbud (*Cercis occidentalis*) and the bright green California buckeye form a pleasing border along the river. Another popular foothill area for spring wildflower watching is the Kings River area of Fresno County, along and upstream of Pine Flat Reservoir.

The Sierra NF is also renowned for the spectacular beauty of botanical diversity in the montane zone to above timberline. Generally streamsides, meadows, and granitic outcrops tend to harbor the most spectacular concentrations of colorful flowers, although roadsides and forest floors can also have eye-catching color. Wandering along a stream or in meadow full of orange leopard lilies (*Lilium pardalinum*), purple larkspur (*Delphinium spp*.), bright pink shooting stars (*Dodecatheon jeffreyi*), yellow coneflower (*Rudbeckia californica*), and blue camas (*Camassia spp*.) is considered one of the most satisfying ways to spend a day for many people.

Trends

The availability of floral diversity for the public to enjoy is maintained and enhanced by ecosystem management practices the Forest Service is implementing in accordance with the most recent science. Forested ecosystems with fire return intervals as similar as possible to those that existed prior to European contact would theoretically maintain naturally high abundance of flowering herbs and shrubs. Timing of burning and other management activity is important for enhancing flowering herbs. Burning in the spring when native wildflower seeds might be steamed to death is less desirable than burning later in the year when burns would have occurred naturally.

For more detailed information on nature watching and wildflower viewing see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 489-556.

Plant Gathering

Species

Plant gathering is an important aspect of multiple-use on the Sierra NF. There are two distinct categories: general public use and tribal use. Among the general public, gathering of boughs, pine cones, greenery, floral decorations, and other miscellaneous forest products for personal use has been part of a free use permit system in the Forest Service for decades. Commercial permits are also sold for the above items and collection of seed and cuttings for commercial use by nurseries or re-vegetation companies occurs occasionally.

Although most species may have a use, some have become scarcer than they were prior to European contact. That is because they are not tended the way they did when the Indians were the primary land

managers. Some species in this category are: deergrass, sourberry, soap plant, white root (sedge), certain species of mushrooms, and others (Anderson 1994, 1999, 2006, Goode, 1992).

Trends

Key ecosystem and management drivers that will affect the trends and conditions of important plant species are fire and forest thinning. A primary mechanism by which fire contributes to the maintenance of culturally important plant species is by limiting the encroachment of competing species. In the absence of fire or forest thinning, many of these species will decline in abundance and mature to a condition where the plant material is not suitable for traditional cultural uses. This has happened for species like deergrass, souberry, and redbud, all of which are of great importance for basket making.

For more detailed information on plant gathering see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 568-640.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Fish, plants and wildlife provide jobs and income to communities, help maintain social cultures, maintain long-standing traditions, connect people to the land, and contribute to the quality of life for many Americans and tribal nations.

Fish

Waters located on National Forest System (NFS) lands are angling destinations, with a projected 11,600,000 visits to national forests in 2011 attributed primarily for angling (USFS 2011). Recreational fishing is also popular across California. During 2006, an estimated 1.7 million anglers spent a projected $2.4 billion associated with fishing in California. Of these total anglers, approximately 1.2 million were associated with freshwater angling, spending an estimated $1.1 billion (USDI-USFWS 2006). With a variety of streams, reservoirs, and high elevation lakes, fishing is also a popular recreation activity on the Sierra NF.

For more detailed information on the contribution of fishing to sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Fish, Plants and Wildlife, lines 177-199.

Wildlife

From 2003 to 2008, the Forest Service's National Visitor Use Monitoring Program (NVUM) reported an annual 14.4 million visits to NFS lands for the primary purpose of hunting (Mockrin et al. 2012). Total expenditures from these visits were almost $1.2 billion for hunting. Annually from 2000 to 2003, hunters spent nearly $50 million in or within 50 miles of Forest Service units in California. These expenditures account for the equivalent of 714 full and part-time jobs and 3.7 million in federal tax revenues. Expenditures are substantially greater when considering all trip-related and equipment purchases within California assigned to Forest Service wildlife recreation (American Sportfishing Association 2008). Comparing these Forest Service expenditures in California with national figures, hunters spent $4.2 billion a year from 2000 to 2003 for Forest Service-oriented hunting activities, supported 97,000 jobs, and generated $505 million in federal income tax revenues.

For more detailed information on the contribution of wildlife to sustainability see the snapshot of the Sierra NF Chapter 8 Fish, Plants and Wildlife, lines 370-446.

Nature Watching and Plant Gathering

Nature watching and plant gathering provides economic and social benefits. Communities benefit economically from visitors who spend money in hotels, restaurants and shops during their visits. As a result, this travel and tourism contributes to local economies by supporting local jobs and earnings. Chapter 6 of this assessment provides information on the importance of visitor spending to the local economies surrounding the Sierra.

Plant species are important to cultural heritage and use. Ethnobotany studies have identified a number of these important cultural species that provide medicine, food and hunting benefits to Native American tribes in California (Reid et. al 2009, Anderson 1996). These benefits may be difficult to value monetarily, but are critical in sustaining and improving the quality of life for those users.

Information Gaps

More complete information on the number and type of users of these resources can be difficult to obtain and interpret. While the license data presented above can provide some insight into this use, not all users of fish, plants and wildlife require licenses and therefore are more difficult to identify.

Chapter 8: Multiple Uses - Range

Important Information Evaluated in this Phase

The range program is described by information related to levels of livestock grazing and the condition of these rangelands. This section will provide information on the animal unit months (AUMs) grazed, number of cattle and permits and the allotments on the Sierra NF. Rangeland condition is described for meadows, riparian and wetland areas, and annual grasslands.

Nature, Extent and Role of Existing Conditions and Future Trends

Livestock Grazing

There is a long history of grazing on the Sierra NF. Grazing was limited to the central valley and foothills until 1861, when cattle were introduced into the current Sequoia-Kings Canyon National Park (Vankat and Major 1978). During the drought periods of 1862-63 and 1876-77, summer grazing was extended into the mountains (Ratliff 1985). Grazing increased dramatically during this time, and while cattle use was widespread, sheep grazing soon became dominant on the Sierra Forest Reserve (Ratliff 1985, Vankat and Major 1978). Sheep numbers in California peaked in the 1870s with about 6.4 million head.

Throughout the 1880s, sheep were driven to the mountains by the hundreds of thousands, and the policy of feed at any cost was well established (West 1935). Overgrazing during this time period was widespread and erosion was extensive (Ratliff 1985, Burcham 1957). Not only did sheep consume forage which would have been available for wildlife, but diseases carried by sheep were transmitted to wildlife,

particularly bighorn sheep (*Ovis, canadensis*) (Ratliff 1985). Regulation of grazing began with the establishment of the National Forest System in 1905-1906. With the large demand for meat during World War I, the depression of the 1930's and World War II, grazing levels were high and grazing lands on the Sierra NF were in poor condition. By the 1950s and 1960s, range analyses were conducted to assess conditions, determine trends, and establish proper stocking rates and seasons of grazing. By 1995, most condition scores showed an improvement in the overall condition as indicated by improved plant species composition and an improvement of total ground cover.

Over time, livestock numbers and the length of grazing seasons were gradually reduced. In 1960, there were 84 grazing permits issued for 36,756 animal months (AM) of use. Of this number, cattle and horses grazed 23,464 AM and sheep grazed 13,292 AM on 40 allotments. In 1964, there were 77 permits issued for 6,062 cattle for 21, 880 AM of use. In 1991, there were 24 grazing permits issued for 5,409 head of cattle. Over time, sheep grazing declined and was replaced by cattle grazing.

Records for the Sierra NF for 2012 show 3,370 head of cattle (mature cow with nursing calf) were permitted to graze during the summer months. Sheep grazing is not authorized on the Sierra NF. A total of 21,247 animal unit months (AUMs) were authorized to graze under a term grazing permit. Another 512 AUMs were authorized to graze in association with private lands intermingled with one allotment under an on/off provision within one of the term grazing permits.

In 2012, the Sierra NF had 22 active cattle and horse permits. Permitted use occurs on 774,828 acres of active allotment acres.

Current livestock numbers grazing on the Sierra NF

	Total numbers on term permits	Total numbers on on/off permits	Total numbers on term private land permits	Total
Total permitted number of cattle	3,370	60	25	3,455
Total permitted AUM of cattle	21,247	512	116	21,875
Total permitted head months(HM) of cattle*	16,152	388	88	16,628
Total permitted number of horses (on cattle permits)	8	0	0	8

* Head month (HM) is one month's use and occupancy of range by one weaned or adult animal, bull, steer, heifer, horse, burro, mule or five sheep or goats.

Livestock numbers found within the three counties that overlap and extend beyond the planning area (Fresno, Madera, and Mariposa Counties) were examined on the broader landscape for grazing activity. The total number of beef cattle across these three counties is 501,840 (Fresno, Madera, and Mariposa 2011 County Crop Reports). The total permitted number of cattle grazed on the Sierra NF is 3,455, or 0.69 percent of the three county totals.

For more detailed information regarding the historical and current livestock use see the July 3, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Range, lines 29-189.

Rangeland Condition

In the early history of the area, Native Americans used the area for hunting and gathering. Their main influence on the vegetation was fire as an aid while hunting game. The Native Americans did not influence meadow vegetation, but instead influenced the Sierra foothill plant communities (Ratliff 1972).

From the mid-1800s through the 1950s, this area experienced heavy use from livestock grazing. There was a need for additional meat during the 1849 Gold Rush, expanding populations in California after the Gold Rush, and during World War I and World War II.

Rangeland condition and trend has been monitored on National Forest System (NFS) lands and on the Sierra NF using various indices and protocols since the 1950s. The Parker 3-Step method was widely applied across U. S. Forest Service rangelands, beginning in 1948 (Parker 1950). This method collected both quantitative and qualitative data and provided a "scoring" technique for determining resource conditions.

By the 1950s, an effort was made on the Sierra NF to conduct range analysis studies to assess conditions, determine trends, and establish proper stocking rates and seasons of grazing. Many of the range condition scores indicated that the forest's grazing ranges were still recovering from the past heavy livestock use from the beginning of the 1900s until the 1960s. By 1995, most condition scores showed an improvement in overall condition (SNEP Rangeland Assessment Menke et al 1996)

Application of the Parker method provided the most comprehensive assessment of rangeland conditions for over 20 years. It used a scorecard approach that was based on very general plant species responses to grazing which is now known to be limited model of plant community dynamics (NRC 1994).

In 1999, the Forest Service initiated a long term meadow condition and trend monitoring program for the national forests in California. Two primary methods were used to sample key sites for condition: 1) rooted frequency of plant species in quadrat frames in riparian areas; and 2) riparian green line sampling along streambanks (Winward 2000). These methods were selected to evaluate condition (also termed ecological status) of range types on key areas. Results from 60 Sierra NF plots are shown in the figure below.

The primary purpose of the program was to 1) document baseline meadow conditions as the Sierra Nevada Forest Plan riparian standards and guidelines were coming into use; and 2) examine long term trends in meadow condition following implementation of these riparian standard and guidelines. The program currently includes 618 permanent meadow vegetation monitoring sites established in key meadows. Vegetation composition is measured at time of site establishment and then every five years following. There are 496 plots within the ten national forests in the Sierra Nevada, 64 of which are on the Sierra NF. As of 2012, a total of 246 sites have been re-read over the past ten years, across 127 grazing allotments. During the period 2000-2012, authorized animal unit months on California national forests declined 27 percent (USDA Forest Service, Range Management Grazing Statistical Summary).

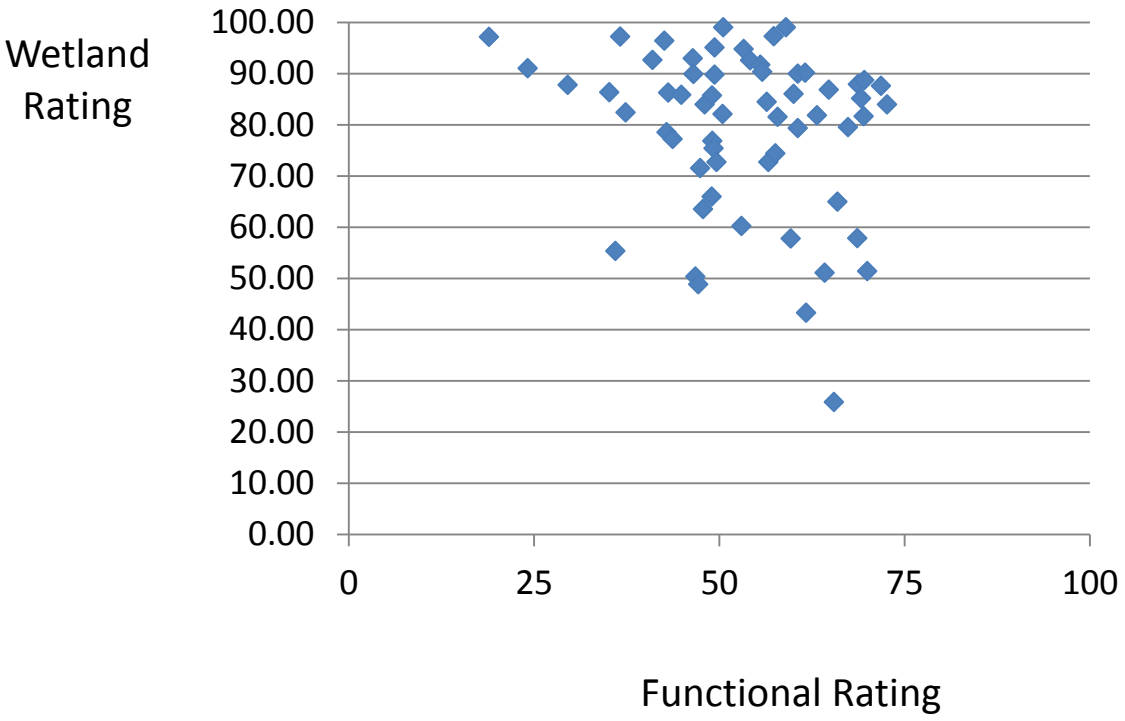
The current grazing resource of the Sierra NF is comprised primarily of annual grassland, blue oak woodland, and montane meadows. Limited grazing also occurs in the timber and brush types. Meadows ranging in size from a few square meters to several hundred hectares are found scattered through virtually every forest type of the montane and subalpine Sierra Nevada.

Meadows

Recent studies have emphasized the importance of meadow ecosystems as centers of biodiversity and links between terrestrial and aquatic systems. Meadow ecosystems are among the environments most disturbed by humans and need restoration to maintain biodiversity and ecological integrity. Meadow systems comprise less than 1 percent of the total area of the Sierra Nevada and Southern Cascade Ranges in California (Ratliff 1985, Sawyer et al. 2007). They are among the most species-rich vegetation types and are heavily used for both recreation and livestock grazing (Fites-Kaufman et al. 2007). Meadows are defined as areas dominated by herbaceous vegetation and generally occur where there is shallow groundwater.

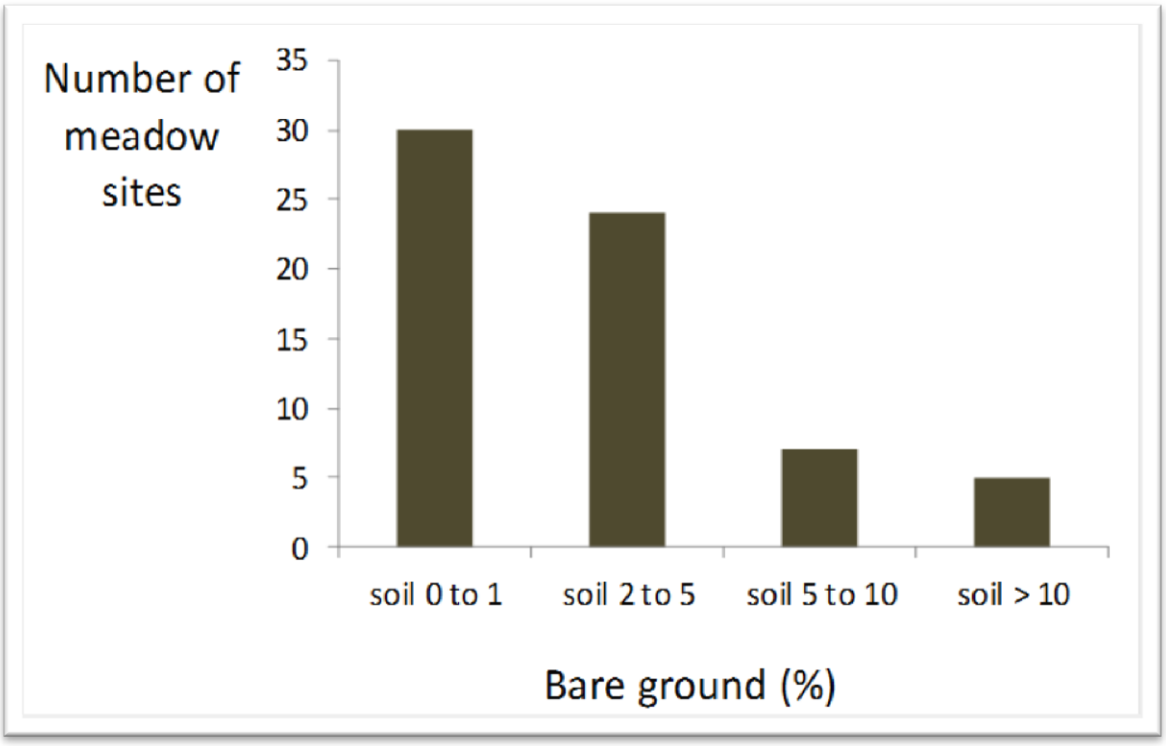
Vegetation changes occur as a result of many factors other than grazing, and disturbance is a natural feature of plant communities (Ruyle and Dyess 2010). Current studies are underway in cooperation with the University of California at Davis to analyze the effects of both grazing management and weather factors in determining meadow condition and trend (see below). Grazing is not necessarily a primary driver of vegetation change and even when grazing has been the cause of vegetation change, current levels of grazing may be inconsequential and even completely removing grazing will not always result in a return to historical conditions (Westoby et al. 1989). Some, perhaps many, altered plant communities can no longer achieve what may have once been a historic condition because of lack of a current seed source, the presence of highly competitive and sometimes exotic introduced plant species and/or changes in soil characteristics limiting species adaptation to the site . These situations are considered state changes in vegetation (Bestelmeyer et al. 2004, 2009, Briske et al. 2008). If current vegetation is a result of climate and disturbance to date, it may be unrealistic to expect vegetation to return to historical conditions especially in the face of global climate change.

The condition of 60 key meadow monitoring sites on the Sierra NF is shown below. The x-axis represents the condition from 0 to 100. A wetland index on the vertical scale indicates the abundance of wetland plant species, the larger the number, the higher the proportion of wetland indicators. On the x-axis, a score above 50 would correspond to the late seral and potential natural vegetation (PNV) categories shown below.



Condition of Meadow Monitoring Sites

The figure below shows the functional rating for 60 key meadow sites on the Sierra NF (from USFS R5 Long Term Monitoring Project data). Axes scores are from Gross et al. (in manuscript to be submitted in 2013). Sites shown represent the long term monitoring plots. Plots were established at key monitoring sites from 1999 to 2004. These plots are revisited every five years. The condition ratings (National Research Council 1994) are 0-25 early seral, 26–50 mid seral, 51-75 late seral, and more than 75 potential natural vegetation (PNV). Condition is from the latest reading for each of the sites.



Frequency distribution of the percent of bare ground on meadows sites on the Sierra NF

Sites below 10 percent bare ground are generally in satisfactory condition in terms of soil stability. A bare ground cover of 10 percent or greater generally indicates significant meadow degradation. The average percent bare ground for meadow sites on the Sierra NF was 6.5 percent. Over 90 percent of the meadow sites sampled indicate high protective ground cover since the data indicate less than 10 percent bare soil.

Additional details on meadow conditions are available in the July 3, 2013 snapshot of the Sierra Living Assessment Chapter 8, Range, lines 269-412.

Conifer Encroachment

The extent of conifer encroachment on the Sierra NF was studied using a protocol developed by MacDonald and Kuitu (2009). The final sample size was 54 meadows in the Dinkey/Tamarack planning area and 65 meadows in the Globe (Beasore) planning area. Ninety percent of the meadows were between 6,000 and 9,000 feet. The mean size of these meadows was about seven acres. Meadow size tended to be larger at the highest and lowest elevations, compared to the mid-elevation range of 6,000-9,000 feet, and there was no clear difference in mean meadow size between the two study areas.

The overall mean encroachment class for the 119 meadows was 2.6, suggesting relatively little encroachment. Twenty-four or 20 percent of the meadows evaluated indicated an increase in size or negative encroachment. The qualitative assessments made for each meadow suggest that this increase in meadow area is most likely a result of logging. Mean encroachment class tended to increase slightly with increasing elevation, and the highest mean encroachment class was for meadows from 7,000-10,000 feet. Since precipitation increases and the length of the snow-free period decreases with increasing elevation, the equal or greater encroachment at higher elevations suggests that encroachment may not be directly associated with drier conditions or snow cover duration. An analysis of meadow size by each encroachment class showed that the two meadows with the highest encroachment class were both much smaller than average. There was no consistent trend in meadow size from encroachment Class 2 (no encroachment) to Class 5 (16-35 percent conifer invasion), as for each of these five classes the mean meadow area was from 2.8 to 3.0 hectares. It is difficult to conclude from this study that smaller meadows are more susceptible to conifer encroachment.

Encroachment on the Sierra NF

Encroachment class	Change in meadow area (% reduction)	Number of meadows (%)	Number (%) of meadows in Dinkey/Tamarack Planning Area	Number (%) of meadows in Globe (Beasore) Planning Area
0	Undeterminable	16 (11.9)	10 (15.6)	6 (8.4)
1	Increase in meadow area	24 (17.8)	8 (12.5)	16 (22.5)
2	(0)	38 (28.1)	17 (26.6)	21 (29.6)
3	(1-5)	33 (24.4)	21 (32.8)	12 (16.9)
4	(6-15)	17 (12.6)	5 (7.8)	12 (16.9)
5	(16-35)	5 (3.7)	2 (3.1)	3 (4.2)
6	(36-60)	2 (1.5)	1 (1.6)	1 (1.4)
7	(61-100)	0 (0)	0 (0)	0 (0)

Additional details regarding conifer encroachment in meadows are available in the July 3, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Range, lines 413-440.

Riparian Condition – Proper Functioning Condition Assessments

Selected riparian-wetland areas within the planning area have been inventoried and monitored to determine whether these areas are functioning properly based on a qualitative assessment of the interaction between vegetation, landform/soils and hydrology to determine hydrologic function. The forest plan standard and guideline is to ensure that characteristics of special features are, at a minimum, at proper functioning condition (PFC). Other rating categories include functional-at-risk (FAR) and non-functional. Additional details regarding riparian condition are available in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Range, lines 441-452.

Hydrologic function of meadow habitats and other special aquatic features during range management analysis

	Total number of assessments	FAR upward trend	FAR no trend apparent	FAR downward trend	Non-functional	PFC
Total number by assessment rating	55	14	8	3	0	30

Annual Grassland Rangeland Condition

Another grazing resource of the Sierra NF is the annual grassland. There are nine active and four vacant annual grassland allotments on the forest. The value of a site for livestock production is dependent on the abundance of desirable forage plant species, forage productivity, and growing season length. A rating of good to excellent defines satisfactory rangeland condition.

Current conditions based on rangeland condition monitoring and analysis conducted between 2001 and 2006

	Total number of active annual grassland allotments	excellent	good	fair	poor
Vegetation score rating condition class by allotment	9	1	6	2	0
Soil score rating condition class by allotment	9	3	5	0	1

Today, annual grasslands occupy what was once pristine native grassland. Annual grasslands consist largely of non-native annuals. They effectively prevent the reestablishment of native perennials over large areas and now comprise climax communities (Heady 1977). Plant succession in the classical sense does not occur in the annual grassland type. Introduced annuals are considered "naturalized" plant species and so are managed for, rather than as invading species which would be characteristic of poorer range sites. However, species composition is greatly influenced by seasonal and annual fluctuations in weather patterns. Botanical composition changes throughout the growing season because of the difference in plant phenology (Heady 1958).

Traditional concepts of range condition and trend are not applicable to California annual grasslands. Variations in precipitation and temperature cause far more variation in species composition and production than do grazing influences, even though livestock grazing can result in temporary changes in species composition (succession). As a general rule, if adequate residual dry matter is left at the end of the grazing season, then condition and overall trend of the annual grasslands are considered meeting or moving toward desired condition (R5 Range Environmental analysis Handbook 1969). A moderate degree of grazing maintains satisfactory litter cover, or residual dry matter, in order to protect against soil deterioration and obtain efficient production from the fluctuating quantity of forage on foothill ranges (Bentley and Talbot 1951). Thus using residual dry matter for monitoring has become the most widely accepted method for managing annual grasslands in California (Stromberg et al. 2007).

Succession presumably proceeds directly from annual grasslands to the tree stages. Most stands of blue oak exist as medium or large tree stages with few to no young blue oaks present. Few areas can be found in California where successful recruitment of blue oaks has occurred since the turn of the century (Holland 1976). This may be due to changes in land use, increased consumption or damage of acorns and seedlings by insects, livestock and native animals, and competition between seedlings and introduced annuals for available soil nutrients and moisture. Where germination of acorns occurs, survival and growth of seedlings typically fail.

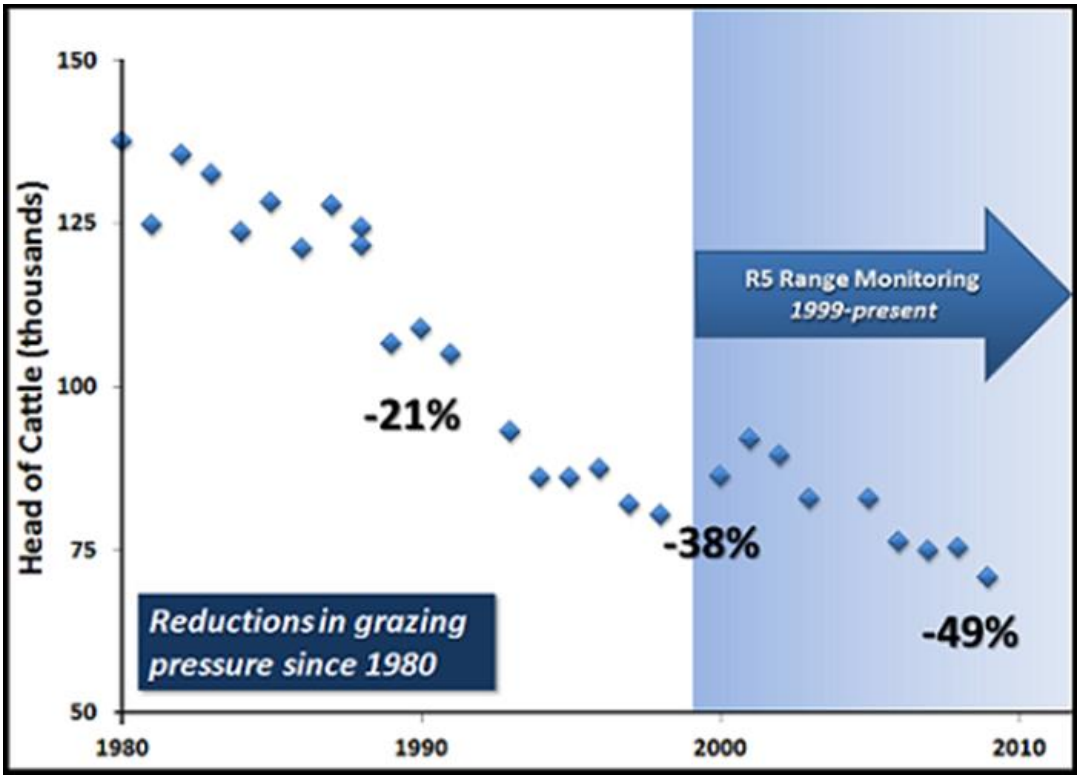
Utilization monitoring in montane meadows consists of determining the percent of forage removed or utilized by weight, and is calculated as a percent use. In annual grasslands, the amount of forage left after the grazing period is calculated as residual dry matter in pounds per acre. Specific grazing standards and guidelines, including allowable use utilization standards and guidelines are outlined in the Sierra NF Land and Resource Management Plan, as amended (USDA Forest Service 1991, 1995, 2001, 2004).

Utilization monitoring within the planning area

Year	Total Key Areas	Total Key Areas Monitored	Total Non-Key Areas Monitored	% of Key Areas Monitored	% Total Monitored within Standard	% Total Monitored not within Standard	Allotments Monitored within Compliance	Allotments Monitored not within Compliance	% Allotments Monitored within Compliance	All Pe Mo Agr
2002	149	97	3	65	85	13	19	4	83	
2003	157	95	9	61	88	7	19	3	86	
2004	157	68	7	43	76	17	12	8	60	
2005	157	45	3	29	90	10	11	3	79	
2006	168	81	1	48	77	21	22	5	81	
2007	168	81	1	48	77	21	22	5	81	
2008	170	105	5	62	95	4	21	6	78	
2009	167	63	0	38	89	10	20	1	95	
2010	-	-	-	-	-	-	-	-	-	
2011	167	22	2	13	129	4	16	0	100	

Additional details for annual grasslands soils and vegetation conditions are available in the July 3, 2013 snapshot of the Sierra Living Assessment for Chapter 8, Range, lines 453-569.

Trends Influencing the Condition of Rangelands and Transitory Range



Trends for head of cattle on Forest Service allotments

This figure represents trend in head of cattle on Forest Service grazing allotments in California from 1980 through 2010 grazing. Reductions in number of head relative to 1980 numbers were 21, 38, and 49 percent in 1990, 2000, and 2010, respectively. The long term meadow condition and trend monitoring program was initiated in 1998.

A preliminary assessment is in progress between the Forest Service and the University of California Davis to estimate trends in meadow conditions over the last 20 years. The study is described below under Information Gaps.

Additional details regarding rangeland trends are available in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, Range, lines 572-601.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Livestock grazing is likely to be sustained within the planning area over the next 20 years based on recent past site-specific range analyses. Projects have been successful in improving livestock management. Additionally, the emphasis of ecological restoration at the watershed scale will contribute to the direct and indirect sustainability of grazing on the Sierra NF.

Meadow restoration is a priority on the Sierra NF. This restoration will sustain and improve the main elevation forage base. The forest uses bio-engineering to stabilize degraded riparian areas to reduce stream bank erosion, improve and restore overall hydrologic function, and remove encroaching conifers.

Livestock use has occurred since the late 1800s and is one of a variety of multiple uses on the Sierra NF that contributes to the economic and social well-being of people. It provides opportunities for economic diversity. It promotes stability for communities that depend on range resources for their livelihood. It meets the public needs for interrelated resource uses by providing livestock forage, wildlife food and habitat, outdoor recreation and other resource values dependent on range vegetation.

The administration of the grazing program on the Sierra NF is intertwined with conservation of California rangeland, primarily in the foothills adjacent to the forest. This is due to an eligibility requirement of Forest Service grazing permits for permittees to own base property ranches when they are not using the forest's rangelands. Properly managed rangeland conserves important ecosystem services including the delivery of fresh water and habitat for native plants and wildlife. Many rural communities continue to be dependent on ranching for their economic livelihood and are located in some of California's fastest-growing communities. The rate of development for non-agricultural uses of California's rangelands exceeds the land conversion rate for forests and croplands combined, and this trend is expected to continue (Wetzel et al. 2012).

Economic sustainability of these ranches owned by permittees over the next 20 years is the most difficult to predict. Their future will depend on the ability to maintain a viable and profitable livestock operation based on the availability of a sustainable forage base. Ranchers are already faced with the need to manage for diverse goals and have been encouraged to produce products with a higher market value, such as organic and natural meats. In most cases, it is the herd size authorized in the Forest Service grazing permit that limits the ability of many permittees to rely on ranch income alone. Each permit has a certain capacity, resulting in a set number of permitted livestock that the range can support for the season of authorized use. Many permittees have already diversified their operation to supplement their income from part-time to full-time off-ranch work.

In order to cope with reductions of National Forest System (NFS) lands for summer grazing, ranchers favor leasing more private land. However, these lands are in short supply and there is strict competition for the leases. This information is summarized in a 2002 University of California Berkeley report to the Sierra Nevada Alliance, California Cattlemen's NFS lands attributed 40 to 50 percent of their income to their access to summer grazing lands. Those interviewed who graze on NFS land said they have no desire to sell their ranches, but a third stated that they would have to consider selling if they lost their Forest Service grazing permit. The majority of ranchers surveyed responded that living and working amidst natural beauty was a highly important reason to continue ranching and that although ranching is not seen as the ideal way to make a living, most ranchers want their children to continue ranching and to pass on the family tradition (Sulak and Huntsinger 2002).

Information gaps

In 2012, the Forest Service and the University of California Davis Rangeland Watershed Laboratory established a partnership to conduct the first comprehensive analysis of the Long Term Monitoring Program dataset. Researchers and Forest Service rangeland specialists are currently in the process of examining these data to determine: 1) meadow conditions and trends; and 2) relationships between

meadow conditions and trends, livestock management, weather and environmental drivers. When the information is available, it will be used to inform the analysis supporting plan revision as applicable. This study will represent the most scientifically updated assessment of trend and response to grazing management, as well as to weather and other factors on national forest meadow and riparian rangelands.

Meadow health will be assessed using the rooted frequency (Bonham 1989) data to calculate a suite of indicators of meadow condition and trend, including species richness, diversity (Simpson's and Shannon-Wiener indices) and evenness. Soil stability scores (Burton et al. 2010, Winward 2000) will also be calculated from plant functional trait groups, which are based on life form, life span, plant height, growth form (clonal or not), and nitrogen fixing ability.

For information and current status of the study go to the University of California Davis rangeland watersheds website.

Preliminary analysis of long term monitoring sites on the Inyo National Forest are presented and discussed at the UCD Rangeland Watershed Laboratory Website.

Chapter 8: Multiple Uses - Timber

Important information evaluated in this phase

- Introduction of how timber harvest and production can play an important role in attaining desired conditions for ecological sustainability and can contribute to social and economic sustainability.
- Identify and evaluate how timber harvest and production contributes to social, economic, and ecological sustainability.

Nature, extent and role of existing conditions and future trends

Current Condition and Future Trends

Of the Sierra NF's 1,319,249 acres, 40 percent (525,869 acres) are productive and available forestland. These acres are about equally split between the Bass Lake and High Sierra Ranger Districts. Productive forestland is capable of growing 20 cubic feet per acre per year. Available forest land is productive forest land not in reserve status through removal of the area from timber use by statute, ordinance, or administrative order (and is identified in the LRMP).

The productive and available forestland is currently classified as 91 percent conifer forest, (481,132 acres), 2 percent hardwoods (8,782 acres), and 7 percent woody shrubs (35,955 acres).

As with other Sierra Nevada west-side forests, vegetation tends to exist in indistinct, north-south elevation bands, and be distributed upslope across the mountain. There are 117,279 acres of ponderosa pine and 237,631 acres of mixed conifer. These acres constitute 45 percent of the available productive forest on the lower and middle slopes. Within, around, and associated with this, are 35,398 acres of other forest types, which are identifiable mostly as Jeffrey pine, lodgepole pine, and subalpine conifers. Most subalpine conifer is not available to timber management generally as it is within designated wilderness. At upper forest elevations, there are 80,775 acres of red fir productive available forest.

Area by land class, county and Sierra NF

County	Ranger District	Productive Forest		Not Productive	Total Forest	Total Non Forest	Total Area
		Available	Not Available				
Madera	Bass Lake	206,712	65,483	45,055	317,250	47,087	364,337
Mariposa	Bass Lake	54,600	1,031	35,033	90,664	2,705	93,369
Total	Bass Lake	261,312	66,514	80,088	407,914	49,792	457,706
Fresno	High Sierra	264,557	277,519	134,786	676,862	184,634	861,496
Inyo/Mono	High Sierra	0	0	3	3	44	47
Total	High Sierra	264,557	277,519	134,789	676,865	184,678	861,543
Total	Sierra NF	525,869	344,033	214,877	1,084,779	234,470	1,319,249

For a more detailed table of acres by vegetation cover types, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8 – Timber, line 424.

Like other Sierra Nevada national forests to the north, the vegetation types occur in a commonly observed pattern of grass, hardwood grass, and hardwood and brush types, gradating into ponderosa pine, mixed conifer, red fir, and subalpine conifers trending toward the mountain crest. On the Sierra NF, the ponderosa pine type may be somewhat narrower and associated with front country basins and cliff-like steep slopes predominately arrayed with hardwood and woody shrub types, prone to wildfire. Included in these areas are Ponderosa Basin in Mariposa, slopes above Oakhurst and Bass Lake, the South Fork Bluffs, Jose Basin below and west of Shaver Lake, Blue Canyon and Grand Bluffs, Barnes Mountain and Haslet Basin.

Unlike national forests to the north, the Sierra NF has a large north-south, high elevation (5,000 to 8,000 feet) ridge system approximately 25 air miles to the west of the Sierra Crest. Vegetation types (extensive ponderosa pine and mixed conifer-pine) east of Chiquito Basin, in the rain shadow, attest to the degree of effect they may contribute to the weather pattern.

Historical volume growth, mortality, and timber harvest on the Sierra NF from the Western Core Table Reports

Tentatively Suitable Productive Forestland (ac)	Annual Net Growth (MMBF)	Ave. Annual Mortality (MMBF)	Mortality as % of Net Growth %	Ave. Annual Vol. Sold 1995-2010 (MMBF)	Ave. Vol. Sold as % of Annual Growth %	Ave. Vol. Sold as % of Annual Mortality %
513,827	229	57	25 %	12.8	6%	22%

Suitable lands are a subset of the productive and available forestlands, where regeneration can be assured, harvest practices are not likely to cause irreversible damage, and where adequate information exists to predict responses to management. The calculation of this acreage value is subject to the inherent limitations of mapping and classification systems. As such, small inclusions of unproductive land, very steep slopes, and other land areas that do not meet the definition of suitable, are coincidentally included in the total. Only with high resolution mapping practices can more of these acreages be recognized and excluded from the grand totals. However, regardless of mapping resolution, site-specific project analysis excludes unsuitable acreages from management actions.

Projected volume growth, mortality, and timber harvest on the Sierra NF

Tentatively Suitable Productive Forestland (ac)	Annual Net Growth (MMBF)	Ave. Annual Mortality (MMBF)	Mortality as % of Net Growth %	Ave. Planned Annual Vol. Sell (MMBF)	Ave. Vol. Sell as % of Annual Growth %	Ave. Vol. Sell as % of Annual Mortality %
513,827	144	36	25%	16	11%	44%

Subsequent steps in the plan revision process will recalculate the tentatively suitable land base acreage.

The Sierra NF moved away from even-aged reforestation management 20 years ago to stand maintenance thinning harvests intended to control density and growth of stands. This was done generally for habitat maintenance. Thinning reduces the number of trees on a site, allowing remaining trees to increase crown and photosynthetic production. It also increases growth rates on the remaining trees. Remaining trees grow larger and faster than those in untreated stands. Once maximum densities are achieved, some larger trees must die or be removed to accommodate population growth. As with most living things, trees species have distinct maximum life spans, and tend to develop a maximum average stand age.

In general, the forest composition is being converted to full tree occupancy. While large individual trees are more resistant to the effects of fire, maintaining full site occupancy in such trees puts the forest at risk from other mortality agents like insect damage.

The current LRMP, as amended by Sierra Nevada Forest Plan Amendments (2001 and 2004), has upper diameter limits for harvest removal trees of 12 inch, 20 inch and 30 inch. These modifications were preceded by the forest plan amendment of 1993, adopting the 1992 California Spotted Owl (CASPO, PSW-GTR-133) interim guidelines. The forest is experiencing re-entry thinning stands where the average stand age, the average stand tree diameter, and average tree growth combine to require removal of trees exceeding these limitations to fully meet restoration objectives. In other words, in stands where density is great enough to consider thinning, the smaller potential cut trees, under current standards, would be too large to harvest.

For restoration purposes, in several vegetation types, especially mixed conifer, reforestation implemented in a group selection, all-aged silvicultural application can increase stand heterogeneity and manage stands for resiliency and wildlife habitat. These patches would create early seral stage patches of shrub or younger age class trees. Within the mixed conifer, about 90 percent of the lands are classified as sawtimber stands, eight percent in pole stands, and only three percent in the seedling or sapling stages.

Increasing early seral stages would address restoration of vegetative characteristics concerning issues such as hiding cover by providing patches with more diverse understory cover .

Wildland Urban Interface Fuels Reduction and Forest Restoration Projects

Several wildland urban interface (WUI) fuels reduction and restoration projects are underway on the Sierra NF. These projects are intended to create strategically located treatment areas to intercept wildfire originating in the more fire-prone foothills below. The University of California, in partnership with the Forest Service, is studying the ecological effects of current forest management practices on parts of the Sierra NF to document the effects of the Sierra Forest Plan Amendment 2004. For additional information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 8, lines 100-123.

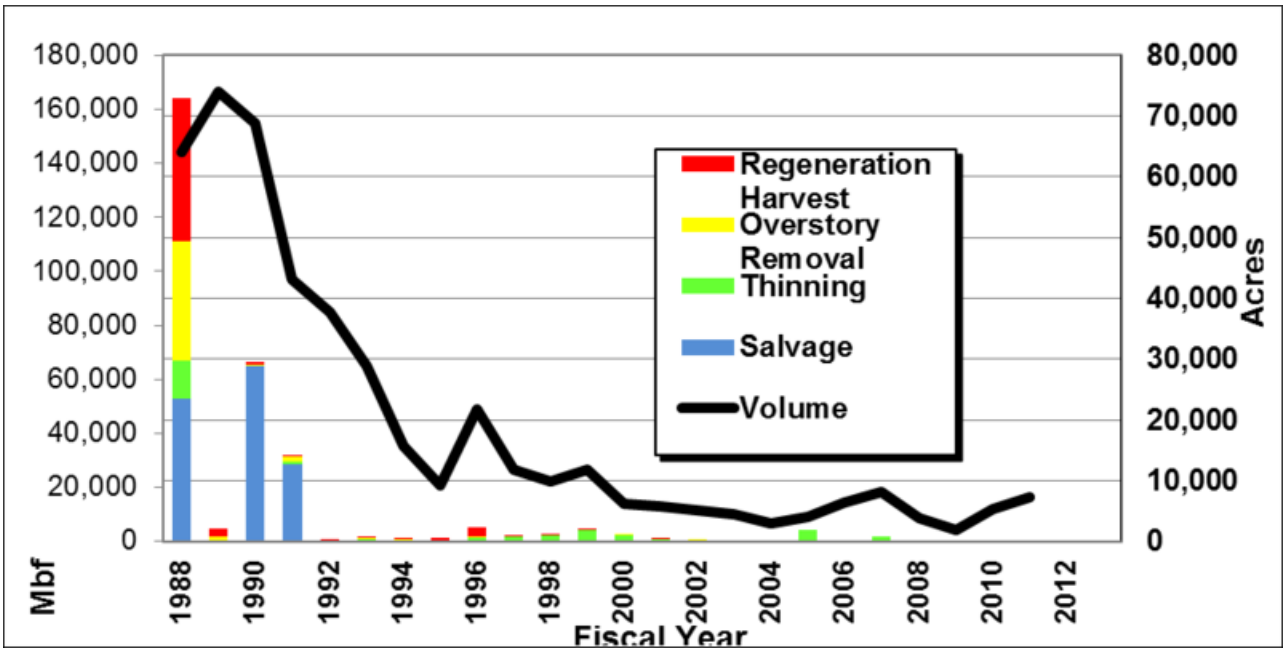
Current levels of timber harvest and production in the plan area and within the broader landscape

Timber Harvest

In the mid-1980s through the 1990s, the Sierra NF had focused on even-aged management, generally known as clear-cutting. Most of this occurred in the ponderosa pine and the mixed conifer vegetation types. It was also performed in red fir. Little contiguous red fir stands of any size exist, having been fragmented by even-aged management.

The five year (2008-2012) rolling average timber volume sold on the Sierra NF was 12.510 million board feet (MMBF). The forest managed an annual planned sell volume for the last three years of 16.000 MMBF, as indicated in the projections from the Forest Plan Amendment 2004.

The figure below displays the change associated with the 1992 Sierra Forest Plan. Management for resource production shifted to management for ecological function.



Sierra NF Timber Harvest displaying shift from management for resource production to management for ecological function

Since the early 2000s, annual timber harvest on the Sierra NF primarily comes from 3-5 large thinning projects, 5-7 public safety hazard removal projects, and other projects to remove trees from special use permit areas. Most of this activity has occurred in the mixed conifer and ponderosa pine vegetation types on the lower and middle slopes. The focus of these activities has been on treating the wildland urban interface (WUI) for fuels management.

The Sierra NF provides timber for three remaining sawmills, Sierra Forest Products in Terra Bella, California, and Sierra Pacific Industries in Chinese Camp, California and Standard, California. The Terra Bella mill is the last remaining mill in California south of Yosemite. Sierra Forest Products operates a wood-fired electrical power plant co-located with that mill.

Firewood

Commercial firewood sales have been sporadic and small in number during the last few years. The forest experienced a decline in permit issuance from 1999 (3,500 permits) to 2004 (1,800 permits), when issuance leveled off at approximately 1,500 permits. Fiscal years 2010 and 2011 had a slight increase in demand for personal-use fuelwood permits, rising to approximately 1,850 permits per year. This demand response may be attributed to an increased supply of available material due to extreme weather events that killed or damaged vegetation, as well as road hazard reduction projects implemented by the Forest Service closer to population centers. Recently, most commercial fuelwood volume is being sold from private lands.

Special Forest Products

The Sierra NF manages the harvest of special forest products (SFP) to protect resources and provide opportunities for use at sustainable levels. The forest program covers only personal use, and there have been no proposals for commercial activities

Special forest products include:

- Forest greenery: primarily sword fern and only partial plant removals are allowed
- Products other than greenery: transplants, Christmas trees, cones, mushrooms, post and poles, and cedar shake bolts
- Firewood: most removal of firewood is for personal use

The Ability of Timber Harvest to Affect Forest Resilience to Stressors such as Fire, Insects, and Disease

Climate Change

Projected future temperatures appear to continue the warming trend, while projections for precipitation are even more uncertain. In the short term, management practices that result in lower tree densities may provide for increased resilience, as well-established research indicates that lower stocking levels result in reduced tree mortality.

Reestablishing forests, after either stand replacement wildfires or purposeful regeneration harvests, with seedlings from selected seed sources may also provide for some level of resilience in the longer-term.

Establishing conifer genotypes from lower elevations or more southerly latitudes may provide for an adaptive advantage when facing a warming climate.

Insects and Disease

The Sierra NF has experienced elevated infestations of western pine beetle over the last five years. Bulaon and Kiehl (2011) determined that:

> No-treatment options within the project area will have effects that may lead to more losses of pine. Based on Oliver's susceptibility indexes, mature plantations remain at high risk against bark beetle infestation. Large expanses of forest mortality may be experienced, creating an immense future fuel load. White fir, a more shade tolerant species, will continue to increase in abundance, potentially outcompeting the pines in the stands. Such imbalances in species diversity in mixed conifer stands lead to higher incidences of root disease and dwarf mistletoe.

While the mixed conifer vegetation type is only a portion of the landscape on the Sierra NF, these stands require significant management attention. Their location, the current condition of the species composition, fuel loading, tree age and size all differ dramatically with the historical condition. The trend to rapidly grow to overstocked conditions puts them in double jeopardy of both fire and insect and disease mortality elements.

Current Capacity and Trend for Logging and Restoration Services and Infrastructure for Processing Wood within the Broader Landscape

The ability of the timber industry to respond to increased timber volume opportunity and production varies with milling infrastructure, logging infrastructure, and product transportation. Transportation may adjust quickly depending on general economic and market alignment. Difficulties in the recovery of this sector involve high capital costs of equipment acquisition, operation, and maintenance, adequate workforce recruitment and training, and improved operating season to support high value employees and their families.

Recently, log transportation costs have increased 20 percent. Traditionally, trucking costs have fluctuated with the cost of fuel and labor costs. Part of the recent increase may be a temporary effect of the "modernization" of the local truck fleet as it updates equipment to new California state standards. Viable trucks are in short supply.

Key Trends that Drive Supply and Demand for Timber or Timber Harvest in the Plan Area

Causes for the decline in firewood utilization may be:

- Fewer commercial logging sales generating slash availability for firewood collecting, although sales are closer to population centers
- Recent operations have targeted “ladder fuels”, but these fuels are more economically reduced through mastication of slash or prescribed fire use, rendering the material uncollectable and useless
- Population demographics indicate the foothills are increasingly being populated with older, generally retired people, with lessening interest in gathering their own supplies
- Increasing use of automatically fed “pellet stoves” over traditional “stick” fed stoves
- Increasing cost of regulated wood burning stoves
- Air quality standards reducing the number of days of allowable wood heating

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Ability of Timber Harvest to Maintain or Restore Key Ecosystem Characteristics Identified in the Assessment of Ecological Sustainability

Vegetation management required to maintain forest habitat under the anticipated environmental stresses described in Chapter 3 of this assessment is critical to respond to increased mortality from drought, fire, insects, and disease. Forest capital resources, both human and financial will be stretched.

The Dinkey Landscape Restoration Project (DLRP) is a science-based ecological restoration strategy that covers 154,000 acres on the Sierra NF. The strategy is both a landscape and stand-level approach that recognizes fire as a dominant ecological process influencing ecosystem processes and vegetation dynamics. Coniferous forests, foothill hardwood forests, and meadows and riparian forests create an integrated, fire-adapted landscape requiring a flexible and adaptive restoration strategy that promotes fire resiliency. Through the use of prescribed fire, mechanical thinning, watershed and other restoration treatments, this project seeks to restore key features of diverse, fire-adapted forests, including heterogeneity at multiple scales, reduced surface and ladder fuels, and terrestrial and aquatic habitats for sensitive wildlife species. The strategy fosters a landscape resilient to uncharacteristic wildfire, insect and disease, climate change, drought, invasive species, and air pollution.

The foundation of much of this restoration strategy rests on a Forest Service Pacific Southwest Research Station General Technical Report- PSW-GTR-220 (North et al. 2009), that provides management direction for much of the DLRP landscape. A major goal of this strategy is to provide current and future habitat for sensitive wildlife species by fostering ecosystem resilience, resistance, and adaptation to future wildfires and accelerated climate change impacts. The Dinkey Landscape Restoration Project focused on two species, Pacific fisher and California spotted owl. These sensitive species are dependent on late-seral conditions, especially within coniferous forests most susceptible to high-severity wildfire. The specialized habitat requirements of these sensitive species guide many of the ecological restoration strategies of the DLRP.

Contribution of Timber Harvest and Production in the Plan Area for Ecological, Social, and Economic Sustainability

Timber requirements are addressed in the 2012 Planning Rule at 36CFR219.11. This section states that plan components must ensure that no timber harvest for the purpose of timber production may occur on lands not suitable for timber production, timber harvest would occur only where soil, slope or other watershed conditions would not be irreversibly damaged, would be carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation and aesthetic resources, and contains direction on the maximum size of openings allowed. The 2012 Rule at 219.11(d)(6) as amended on April 19, 2013 states that the "quantity of timber that may be sold from the national forest is limited to an amount equal to or less than that which can be removed from such forest annually in perpetuity on a sustained yield basis." The 1992 Sierra Plan calculated sustained yield of 17 MMcf. This plan was amended by the 2004 Sierra Nevada Framework which on page 15 of the Record of Decision states that "This decision does not change the capable, available and suitable (CAS) lands determination made in forest plans. This decision does not schedule any regulated timber harvest from these lands. Scheduling of regulated timber harvest and its associated Allowable Sale Quantity (ASQ) will be addressed as part of forest plan revisions." This will be addressed in the NEPA analysis phase of the upcoming Sierra NF plan revision effort including the calculation of an updated long term sustained-yield.

The average acre on the Sierra NF is growing 448 board feet annually. Mortality is removing 111 board feet annually, for an average net gain of 337 board feet per acre per year. The current timber program calls for harvests of 16 million board feet per year or a general average of 67 board feet per acre per year, well below the growth rate. This harvest is mostly smaller understory growing stock, and a portion of the mortality occurring in hazardous areas near roads, campgrounds, special use facilities, and other area of common public use.

Maintenance of business infrastructure to support Forest Service restoration goals is a critical concern for the Sierra NF, the tribes, other agencies and public utilities. Markets for excess or hazardous timber help defray the costs of required maintenance for facilities, roads, and fuels management. The business infrastructure most dependent on vegetation and timber management are lumber milling and logging entities. Log transportation is also required. They are related and integrated, but must grapple with similar but separate issues. The current forest timber program estimated a sustainable production level of approximately 16 million board feet (MMBF) average per year, for the Sierra NF. Timber industry representatives say that approximately 25 MMBF will be needed from the Sierra and Sequoia NFs for the last remaining local sawmill infrastructure south of Yosemite National Park. One shift of 130 employees at that that mill requires approximately 30 MMBF annually.

Information Gaps

The yield tables commonly employed to determine desired stocking levels were generally developed in the late 1920s and early 1930s (Meyer, Dunning and Reineke, Schumacher), when vegetation had been growing under cooler and wetter conditions than what is currently being experienced. Use of these stocking guides should be adjusted for warmer, drier conditions possibly leading to decreased site productivity (reduced stocking and growth potential).

Chapter 9: Recreation Settings, Opportunities and Access, and Scenic Character

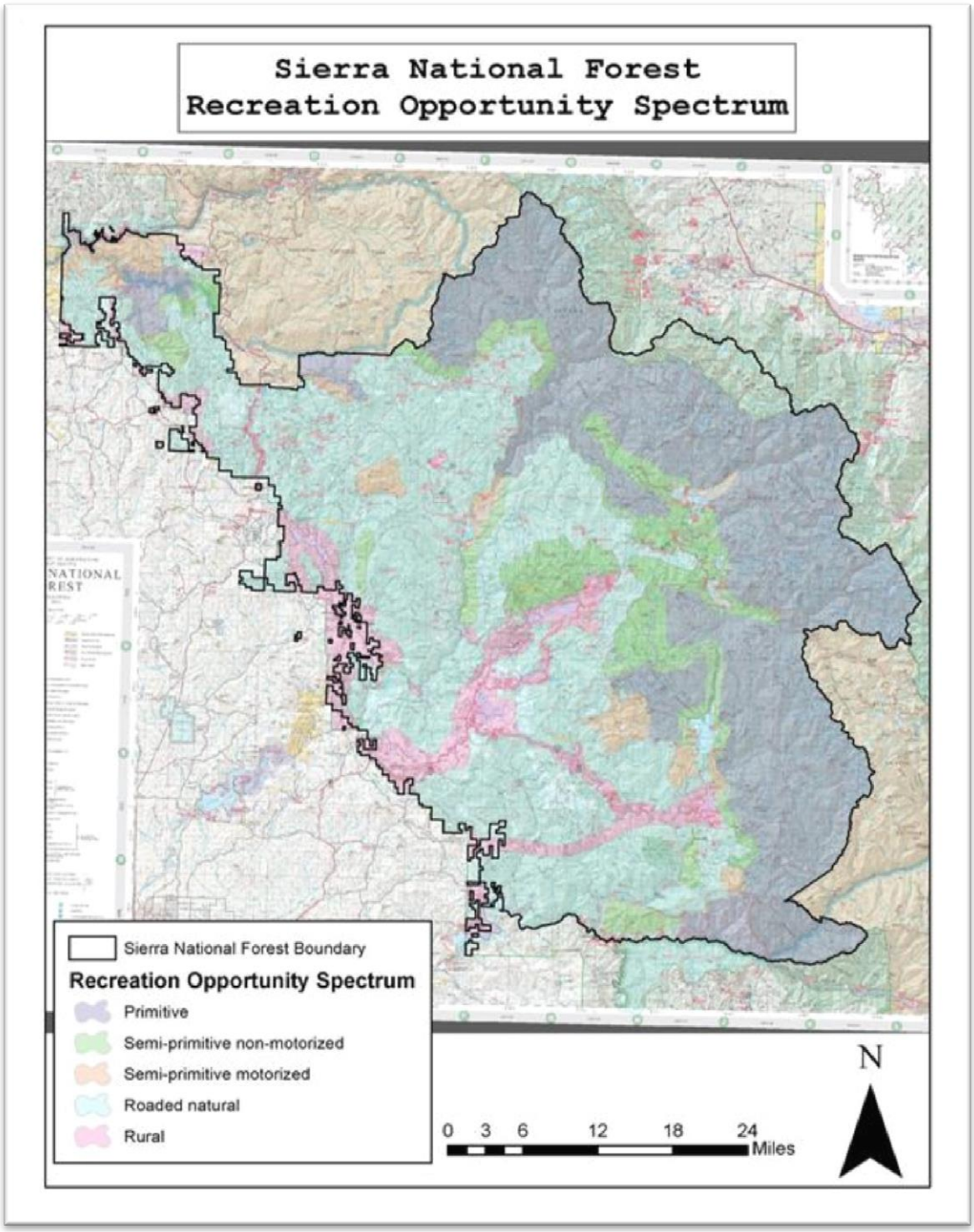
Important information evaluated in this phase.

Existing, relevant information about recreation settings, opportunities, access, and scenic character of the plan area were identified and evaluated. Factors outside the plan area that may influence the demand for recreation in the plan area or the ability of the plan area to meet those demands were also evaluated. Finally, this information was used to discuss the sustainability of recreation in the plan area. This information largely comes from the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapters 6 and 9. Additional information also comes from the draft Sierra Nevada Bio-Regional Assessment.

Nature, Extent and Role of Existing Conditions and Future Trends

Recreational Settings

Recreation settings are the social, managerial, and physical attributes of a place that, when combined, provide a distinct set of recreation opportunities. The Forest Service uses the Recreation Opportunity Spectrum (ROS) to define recreation settings and categorize them into six distinct classes: primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, rural, and urban (36 CFR 219.19). The ROS system was developed to support the planning direction under the 1982 Planning Rule. The ROS for the Sierra NF was originally determined in 1986. The map below displays the ROS classes on the Sierra NF.



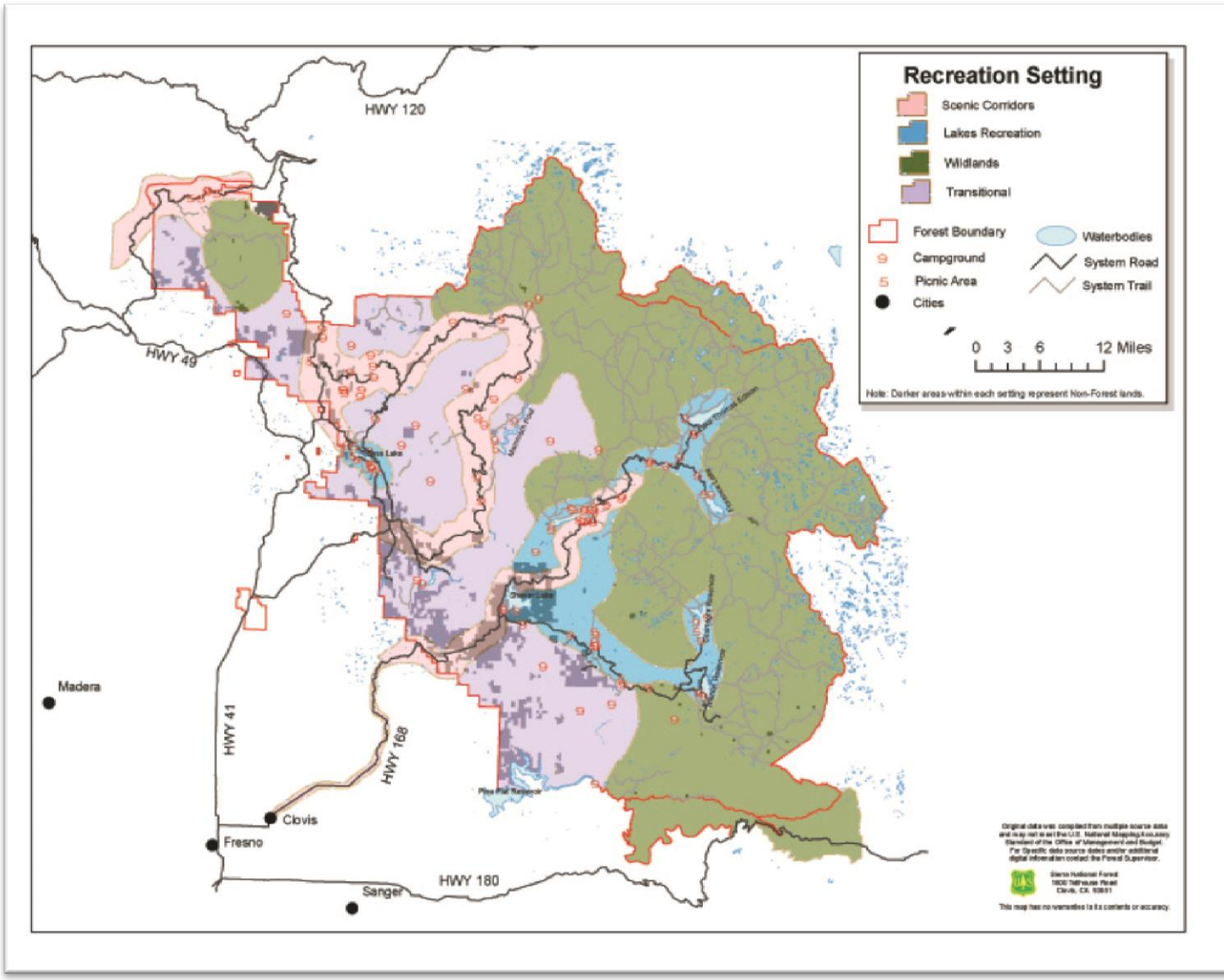
Sierra NF Recreation Opportunity Spectrum map

Overall, the ROS classifications on the Sierra NF have not changed since their development in 1986. However, during project-level work, incompatibilities between the ROS classifications and recreation activities have been identified. One incompatible activity occurring on the forest is the use of motor vehicles in semi-primitive non-motorized areas. In some cases, temporary roads from past timber sales were not closed and then became established for motorized use. The motorized travel management analysis found national forest transportation system (NFTS) roads in the semi-primitive non-motorized class along the South Fork Bluffs. As a result, 1,074 acres were changed in the Motorized Travel Management Record of Decision from semi-primitive non-motorized to semi-primitive motorized to accommodate 1.6 miles of motorized trails. ROS classifications on the forest have not been updated to reflect this change to the NFTS. No information is currently available on additional inconsistencies with ROS classes that may be present on the forest.

Recreation Facility Analyses (RFAs) were conducted nation-wide to address growing concern about the agency's ability to maintain recreation sites to meet the needs of the public. In 2007, the Sierra NF completed an RFA to develop a 5-year program of work to align management of recreation sites and facilities with the forest's recreation niche and economic capability. Since 2007, national forest recreation programs throughout the country have been guided by recreation niche statements and complementary niche settings developed through the RFA process. Niche statements broadly define the scope of a national forest's recreation program and highlight those aspects that are distinctive.

The following is the niche statement for the Sierra NF:

> *From lakeside camping and picnicking to wilderness solitude, the Sierra National Forest is destination recreation. With intensely used and highly developed lakes and the world famous Ansel Adams and John Muir Wildernesses, the Sierra provides the extreme ends of recreation settings. These sharp contrasts provide destinations for visitors to escape from the heat and routine urban life, connect with nature, family and friends. Given the proximity to large, diverse and growing urban areas the Forest has a responsibility to provide heritage and conservation education to sustain this incredible landscape for future generations.*



Sierra NF recreation niche settings map

As shown on the map above, the Sierra NF has four niche settings: wildlands, lakes recreation, scenic corridors, and transitional. These settings represent the geographic areas that provide a contiguous backdrop for particular opportunities and activities. ROS classes are finer-scale subdivisions of these niche settings. Wildlands are remote high-elevation forested landscapes with limited or primitive improvements, and include congressionally designated wilderness areas. Lakes recreation areas include large lakes located within a natural conifer setting. Scenic corridors are popular paved driving routes, including two national scenic byways, which connect people from lowlands to high elevation areas, providing dramatic geologic, historic, and vegetative contrasts. Transitional areas occur at lower elevations and are front-country, forest-urban transition landscapes. According to the RFA, current recreation sites generally conform to some but not all niche settings.

For more information on niche settings see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 165-201.

The following table shows the total number of acres within each combination of niche setting and ROS class. A relatively small percentage of the forest (90 acres) is within the urban ROS class and is not included in the table. These 90 acres are within the Lakes Recreation niche setting.

Total acres within each combination of niche setting and ROS class

Niche Setting	ROS Class						
	Primitive	Semi-Primitive Non-Motorized	Semi-Primitive Motorized	Roaded Natural	Rural	Niche Setting Acres	Percent Total Acres
Wildlands	500,119	99,027	19,624	128,007	5,068	751,845	52.5%
Lakes Recreation	7,903	21,010	5,031	59,639	34,776	128,359	9.0%
Scenic Corridors	618	1,564	7,706	114,647	44,419	168,954	11.8 %
Transitional	7,140	10,479	13,408	304,093	48,739	383,859	26.8 %
ROS Class Acres	515,780	132,080	45,769	606,386	133,002	1,433,017	100.0%
Percent Total Acres	36.0%	9.2%	3.2%	42.3%	9.3 %	100%	--

Conditions and trends affecting recreation settings are further discussed in the sections below by examining the components that contribute to recreation settings, including opportunities, access, and scenic character section.

Recreational Opportunities

A recreation opportunity is an opportunity to participate in a specific recreation activity in a particular recreation setting to enjoy desired recreation experiences and other benefits that accrue. Recreation opportunities include non-motorized, motorized, developed, and dispersed recreation on land, water, and in the air (36 CFR 219.19). The opportunities may be provided by the Forest Service or through a concessionaire under a special use permit.

Developed Recreation

The Sierra NF offers a range of developed recreation across 14 areas of the forest. Some facilities are open year round and others are open from Memorial Day through Labor Day weekend. About 62 percent of facilities have site modification levels that provide visitor convenience and comfort. The other 38 percent have site modification levels where rustic or rudimentary modifications may be provided for resource protection. Chapter 11 of this assessment has additional information on developed recreation facilities.

Developed recreation across the forest

Recreation Facility	Bass Lake	Blue Canyon	Clover Meadow	Courtright/Wishon	Dinkey Creek	Edicon/Florence	Huntington Lake	Kings River	Mammoth Pool	Merced	Redinger	Shaver Lake	Sky Ranch	Wilderness	Total
Boating Site	1			2		2	1	1	1		1				9
Campground	10	1	3	5	3	7	11	3	10	2		2	9		66
Camping Area	3		5	10	12	2	11	2	3				5	6	59
Day Use Area				1				1							2
Fishing Site				4											4
Visitor Information	1		1		1		1								4
Interpretive/Observation Site			4	1		1			2		1	1	1		11
Picnic Site	8			2	3	2	3		1	4		1	1		25
Snow Play													1		1
Trailhead/Staging Area	6	3	3	4	3	8	11	3				1	9		51
Total	29	4	16	29	22	22	38	10	17	6	2	5	26	6	232

Dispersed Recreation

Dispersed recreation consists of those activities that take place after the motor vehicle stops. At the time of this writing, 943 locations were identified on the Motor Vehicle Use Map (MVUM) where visitors park in order to camp, fish, hunt, use off-highway vehicles, and hike. In addition, there are 51 trailheads and staging areas where visitors begin their dispersed recreation activities like hiking or using off-highway vehicles. Dispersed use also occurs in the winter. There are five snow parks that provide access to cross-country ski and snowmobile trails, among other winter activities. Water-based activities like waterskiing, personal watercraft, and whitewater rafting are types of dispersed recreation that occur on the forest. There are a few toilet facilities supporting dispersed recreation activities along the Kings River and at the top of Kaiser Pass. These facilities meet Forest Service standards.

Important Recreation Sites or Areas

Bass Lake: Boating, fishing, swimming, waterskiing, and camping are available at this mid-elevation lake, which is accessible year round. The southwest side of the lake has 16 facilities with a capacity of 2,890 people. Through a partnership with Pacific Gas and Electric (PG&E), eight facilities have been upgraded and improved to standard. The remaining have functioning tables, fire rings and restrooms, however the facilities do not meet current accessibility standards. There are 21 recreation residences and

two resorts offering overnight facilities, restaurants, and marinas. The northeast side of the lake is private property and densely developed with single family residents. These facilities are in the lakes recreation niche setting and in the urban ROS class.

Courtright/Wishon: These beautiful lakes with spectacular high Sierra scenery offer camping, boating, hiking, and fishing. The area has 19 facilities with a capacity of 1,395 people. PG&E operates and maintains nine of the facilities. The developed facilities in this area have functioning tables, fire rings, and restrooms, however, the facilities do not meet current accessibility standards. There is one resort offering camping, RV sites, a store, restaurant, bar, and marina. There is private property developed with single family housing north of Trapper Springs. These facilities are in the lakes recreation niche setting. They provide access to the wildlands setting, and are in the rural ROS class with access to semi-primitive motorized, semi-primitive non-motorized and primitive ROS classes.

Dinkey Creek: Facilities are spread out along the banks of the creek in a forest of ponderosa pines and cedars, making this a scenic destination for all types of visitors. The area has four facilities with a capacity of 825 people. Dinkey Creek Campground has been refurbished and meets current Forest Service standards. One picnic area has accessible restroom facilities, and the remaining features and facilities do not meet current accessibility standards. There is one resort offering year round cabin rentals, a seasonal store, and food service. Nearby, there is outfitting and guiding for horseback riding, an organized camp, and 43 recreation residences. These facilities are in the lakes recreation niche setting and provide access to the wildlands setting. They are in the rural ROS class.

Edison/Florence: Developed and primitive campgrounds grace the shores of these beautiful high country lakes, surrounded by the Ansel Adams and John Muir Wildernesses. Boating and fishing are available, and wilderness trailheads are located nearby. Narrow winding approach roads prohibit access by large motorhomes and trailers. This area has 29 facilities with a capacity of 2,297 people. These facilities do not meet current accessibility standards and tend to be in poor condition. There are two resorts offering overnight facilities, a restaurant, a store, and ferry service. There are also wilderness outfitting and guiding services. An additional resort offering overnight stays is located in the wilderness on private property. These facilities are in the lakes recreation and scenic corridors niche settings and provide access to the wildlands setting. They are in the roaded natural ROS class with access to semi-primitive motorized, semi-primitive non-motorized and primitive.

Huntington Lake: This scenic, high country lake offers excellent fishing, camping, and hiking. Summer sailboat regattas also draw visitors. The area has 15 facilities with a capacity of 2,430. Through a partnership with Southern California Edison, three facilities have been upgraded and improved to standard. The remaining facilities have functioning tables, fire rings, and restrooms, but do not meet current accessibility standards. There are seven resorts offering combinations of overnight facilities, stores, restaurants, marinas, and RV campsites. There are six organized camps around the lake. This area has a strong winter recreation component and includes China Peak Ski Area, snow play areas, and snowmobile and cross country ski trails. There is private property developed with condominium-type housing north of College Campground. These facilities are in the lakes recreation and scenic corridors niche settings, and in the rural ROS class with access to primitive.

Wilderness: There are five wildernesses on the Sierra NF totaling 546,059 acres: Ansel Adams, Dinkey Lakes, Kaiser, John Muir, and Monarch. The Dinkey Lakes and Kaiser Wildernesses are entirely within the boundaries of the Sierra NF. The Ansel Adams and John Muir share management with the Inyo NF,

and the Monarch is managed by the Sequoia NF. All are in the wildlands niche setting and in the primitive ROS class. See Chapter 15 of this assessment for more information on wilderness.

For more information on important recreation sites or areas on the Sierra NF, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 660-711.

Special Uses

Recreation special use permits allow for occupancy and use of the national forests. Permitted recreation uses provide opportunities to the public for services not offered by the Forest Service and deliver economic benefits to rural economies. Some uses are commercial enterprises that offer services for a fee. They are operated by businesses, private entrepreneurs, non-profit groups, and semi-public agencies. Examples include outfitting and guiding, resorts, campgrounds, organizational camps, and private camps. Non-commercial recreation uses consist of sites or activities that do not serve the general public but are reserved for use by specific groups, such as clubs or by individuals and families. All special uses go through a screening and approval process, environmental analysis under National Environmental Policy Act (NEPA) procedures, and other required analysis before a permit may be issued. The Forest Service issues permits for the minimum time necessary to accommodate the use, ranging from a single day up to a maximum of 40 years.

The Sierra NF currently manages 647 active special use authorizations that cover 12 different types of specials uses. For definitions of these use types, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 264-303. Based on information pulled in December 2012 from the Special Uses Data System (SUDS), the current number of sites on the Sierra NF with special use authorizations is shown in the table below. A single permit can authorize use in multiple forest locations; therefore, the total number of permitted sites is greater than 647. By far, recreation residences account for the greatest number of special use authorizations that occur on the forest.

Special use authorizations on the Sierra NF

Type of Special Use Permit	Bass Lake	Blue Canyon	Clover Meadow	Courtright/Wishon	Dinkey Creek	Edison/Florence	Huntington Lake	Kings River	Mammoth Pool	Merced	Redinger	Shaver Lake	Sky Ranch	Wilderness	Total
Resort	2		1	1	2	5	7			1			1		20
Organization Camp	1				1		7		1	1			1		12
Private Camp	1						1						1		3
Club	1														1
Recreation Residence	22				43		491								556
Isolated Cabin							1								1
Recreation Event	1	2		1	3		3		1				2		13
Outfitting and Guiding	2		6	3	1	4		5	2	1			3	14	41
Concession Campground	21		1	1	7	9	17		10	6		3	10		85
Boat Dock	1						9								10
Noncommercial Group Use								1							1
Traditional Cultural Use by Indians and Indian Tribes												1			1
Total	52	2	8	6	57	18	536	6	14	9	0	4	18	14	744

Conditions and trends affecting recreation opportunities

Recreation opportunities are affected by recreational trends and the mix of outdoor activities chosen by the public, which continuously evolve (USFS 2012a). Visitor use and visitor satisfaction can help us understand what types of activities people are interested in and the quality of their experiences. According to National Visitor Use Monitoring (NVUM) data from fiscal year 2007, which was the latest round of surveys, annual visitation was estimated at 1.18 million people.

The most popular activities that visitors participated in were:

- viewing natural features (49 percent)
- relaxing (48.4 percent)
- other non-motorized activities (43.7 percent)
- hiking/walking (40.7 percent)
- viewing wildlife (21.6 percent)
- picnicking (20.2 percent)

See the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, line 250 for the full list of visitor participation in activities. However, NVUM data is limited and does not cover the full suite of recreation activities that take place on the forest, particularly emerging or relatively new activities. Overall visitor satisfaction was high on the Sierra NF: 73.8 percent of visitors were very satisfied with their visit and 19.8 percent were somewhat satisfied. However, population growth, increasing demand for recreation opportunities, and changing demographics may impact the quality of experiences in the future.

Social, cultural, and economic conditions influence the demand for various types of recreation activities. The development of hydroelectric generating facilities has greatly shaped the landscape and recreation on the Sierra NF. Eleven reservoirs provide a diversity of recreation opportunities, each attracting different social and cultural visitors based on distance, amenities provided, and available space to recreate as desired. Family traditions also influence recreation preferences. Visitation to wilderness, high mountain lakes and reservoirs, and other out of the way places are, for the most part, driven by the economics of the visitor.

The majority of visitors come from Sierra NF counties or those nearby. Based on 2007 NVUM data, the table below lists the distance travelled by visitors to the forest. Compared to 2003 NVUM data, the percent of visitors travelling over 200 miles has decreased from approximately 50 percent to 20 percent. In 2007, about 43 percent of 2007 NVUM survey respondents came from Fresno County, with an additional 10 percent from Madera County, 2 percent from Mariposa County, and 4 percent from Tulare County. People from southern California also accounted for a fairly substantial percentage of total visits.

Distance traveled by visitors to the forest

Distance travelled from home	Percent total visits to the Sierra NF
0 - 25 miles	10.8
26 - 50 miles	15.8
51 - 75 miles	34.2
76 - 100 miles	6.0
101 - 200 miles	13.6
201 - 500 miles	13.0
Over 500 miles	6.5
Total	99.9

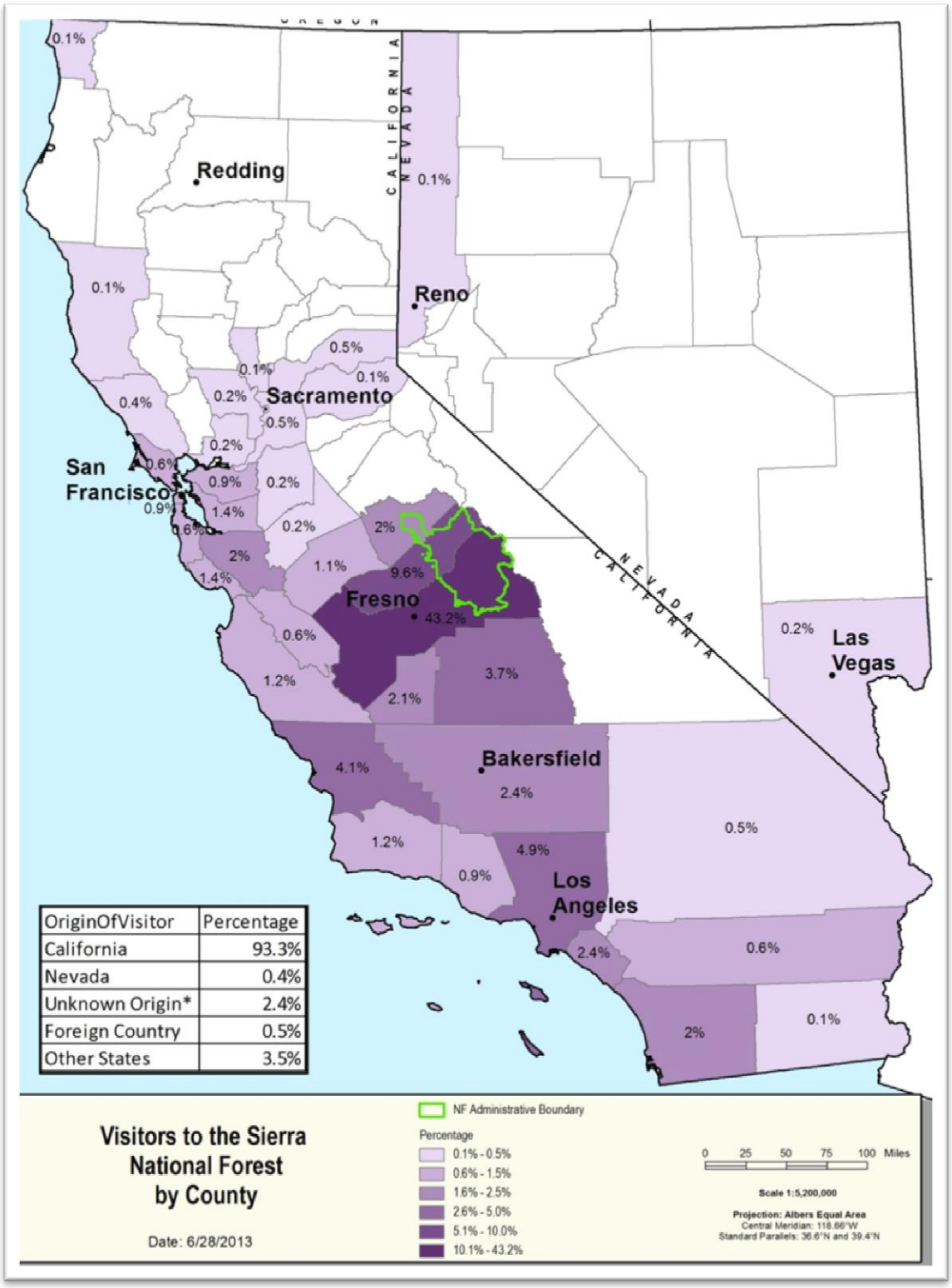
Population growth in many of these areas is expected to increase demand for recreation opportunities on the Sierra NF and may increase user conflict. According to 2010 census data, over one million people live within one hour of the Sierra NF. Population of the cities and towns near the forest are increasing. Based on 2000 and 2010 census data, the population within one hour of the forest increased 33 percent. City and towns within one hour of the forest increased 28 percent in Fresno County, 58 percent in Madera County, and 89 percent in Mariposa County. As described in the 2010 Millerton State Recreation Area General Plan, Fresno and Madera Counties are expected to have much greater population growth than the state average over the next 20 years. As a result, the number of people participating in recreational activities may increase as well. However, other factors such as economic conditions and gas prices can heavily

influence growth rates and participation in recreational activities. Fresno and Madera Counties have lower income levels, higher poverty rates, and lower education levels compared to the state.

No demographic trend is of greater importance to national forest managers and leaders than the immense growth of cultural diversity in the state (Roberts et al. 2009). While cultural diversity is much lower in local gateway communities, almost 50 percent of people living in the three-county area that intersects the Sierra NF (Mariposa, Madera, and Fresno) are Latino or Hispanic. For more information on shifting demographics, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 326-367. Shifting demographics are expected to change recreation demands on national forests and may impact visitor satisfaction. The prominence of Latino and Asian values and vision is expected to increase as these two cultural groups increase in size and influence (Roberts et al. 2009). For example, research indicates that many ethnically diverse groups prefer more developed sites that have picnic tables, grills, trash cans, and flush toilets (Roberts et al. 2009). Currently, people from culturally diverse backgrounds are still underrepresented as forest visitors. Forest management can create barriers to use and enjoyment (e.g. language and lack of information) by the growing population of ethnic minorities in California and the United States as a whole (Roberts et al. 2009).

Nationally, increases in site-based activities, such as camping in developed sites and family gatherings, and in viewing and photographing nature are occurring (Cordell 2012, as cited in Winter et al. 2013). Camping in developed areas is a popular recreation activity on the Sierra NF. Many people camp to escape the Central Valley heat and to go fishing or boating. Almost all campsites in the Bass Lake and Huntington Lake basins are full in July and August. With the number and closeness of campers, there are complaints about noise and disruptive individuals. As campsites fill up, those without reservations either find a first come-first serve campground further away, or a dispersed recreation site. Developed recreation facilities further away from the destination lake do not have flush toilets, and dispersed recreation sites do not have any toilets. As a result, recreation visitor experience and expectations for developed camping are not met.

The map below shows California and Nevada with county boundaries delineated for each state. There is also a boundary of the Sierra NF. Within applicable counties, the percentage of total 2007 NVUM survey respondents to the Sierra NF who originated from that county is indicated. County level percentages range from 0 percent to 43.2 percent of total respondents. Darker shades indicate higher percentages and lighter shades indicate lower percentages. There is also a table on the map that shows the percent of visitors originating from California (93.3 percent), Nevada (0.4 percent), other states (3.5 percent), foreign countries (0.5 percent), and unknown origins (2.4 percent).



Visitors to the Sierra NF by county

This trend has resulted in a growing number of people using undeveloped areas who are not informed about forest rules, regulations, ethics, and sanitation in an undeveloped environment. These sites, if not managed properly, tend to become party areas, target shooting areas, dump sites for refuse, illegal drug manufacturing areas, and unmanaged off highway vehicle areas causing resource damage. In addition, some people leave their recreation vehicles at dispersed recreation sites throughout the summer and into the fall. Because they are being used on a regular or semi-regular basis, these vehicles are not considered abandoned. These practices result in sanitation concerns.

Dispersed recreation sites are experiencing crowding as well. Tamarack, Coyote, and Balsam snow parks exceed capacity on weekends and holidays, resulting in unsafe conditions due to visitors parking along State Highway 168. Use of personal watercraft on popular lakes has increased in recent years, although the trend seems to be stabilizing. There is also an increasing trend in operating watercraft closer to shore, which can be hazardous for swimmers. While overall visitor satisfaction appears quite high, lower levels of satisfaction were found for undeveloped areas compared to other site types. Areas needing improvement include interpretive displays, recreation information availability, and sign adequacy. There is interest in more dispersed sites, however very limited resources are available on the forest.

The availability of recreation opportunities on other lands within the broader landscape can impact recreation on the Sierra NF. Yosemite and Sequoia-Kings Canyon National Parks also provide high-quality scenery and recreation opportunities outside the boundary of the Sierra NF. The Sequoia, Inyo, and Sierra NFs account for 45 percent of all recreation visitor days on National Forest System (NFS) lands in the Sierra Nevada. Together with the adjacent national parks, this portion of the Sierra Nevada probably has one of the highest recreation activity levels in the world (USFS 2012b). Millerton Lake State Recreation Area, located between Fresno and the Sierra NF, is a popular area for its wildlife, scenery, and water-based recreation activities (Bureau of Reclamation and California Department of Parks and Recreation 2010).

Local government planning can also influence recreation opportunities in the plan areas. According to the general plans for Fresno County (2000), Madera County (1995), and Mariposa County (2006), protecting scenery resources and promoting recreation and tourism are important to all three counties. These plans also include goals for coordinating with federal and state agencies for conservation and recreation purposes. These plans include references to developing or expanding trail systems and other facilities. The counties promote continued and expanded use of federal public lands to meet the recreation needs of county residents. Major portions of Madera and Fresno Counties are located in the Central Valley, which is considered an underserved region for parks, recreation facilities, programs, and services (California Department of Parks and Recreation 2009). Growing populations in the Central Valley may increase the demand for recreation opportunities on Sierra Nevada national forests. The Shaver Lake Community Plan (Fresno County 1978) aims to improve the Shaver Lake economy through recreational uses. Goals include maintaining and developing new recreation facilities and multi-use trails.

Opportunities to Foster Greater Connection between People and Nature

The Sierra NF offers a variety of opportunities that connect people and nature through its recreation program. However, Americans have become increasingly disconnected from the outdoors and our natural and cultural heritage (Council on Environmental Quality et al. 2011). The nearly 80 percent of Americans who live in urban areas find it particularly difficult to connect with the outdoors, children spend less than half as much time outside as their parents did, and are “plugged in” to electronic devices for more than seven hours a day (Council on Environmental Quality et al. 2011).

Increasing understanding about the natural environment and helping more people have positive outdoor experiences can create a citizenry that understands the importance of being good stewards of the land. Conservation education and interpretation can play a key role in helping to foster greater connection between people and nature. These programs offer opportunities for experiential learning that can help improve understanding of complex resource issues. In addition, they can be effective tools for encouraging collaboration in resource management. Partnership and volunteer programs can play a vital role by reaching out to a broad and diverse group of citizens and getting them involved on the Sierra NF. These programs are essential to helping the Forest Service carry out its mission, and can help citizens feel a direct and meaningful connection with the land. Opportunities for fostering connection between people and nature are especially apparent within urban communities and with traditionally underrepresented groups like youth, low-income populations, and minority populations. Current recreation opportunities and communication and information approaches may be a poor fit for these communities (Winter et al. 2013).

Recreational Access

Recreation access is the nature, extent, and condition of trails, roads, and other transportation that connects people to recreation settings and opportunities. Recreation access is provided by state highways, county roads, and Forest Service roads and trails. Roads and trails not only provide access to recreation opportunities, but are themselves a recreation experience. State Highways 41, 140, and 168 provide views of mountains, rock formations, and forests. County roads such as Dinkey Creek, Huntington Lake, Miami Mountain, and Chowchilla Mountain provide access from the state highway to forest opportunities. They tend to be closer to recreation opportunities. Forest roads offer scenic views and provide direct access to trailheads, staging areas, campgrounds, and picnic facilities. They also provide access to parking areas for fishing, hunting, and water-based recreation. Roads to major developed sites like Bass Lake or Huntington Lake are mostly state highways and provide excellent opportunities for viewing scenery. Roads to dispersed recreation, including motorized and non-motorized trails tend to be low standard, single lane dirt roads that are not maintained for passenger cars. With declining federal budgets, the Sierra NF has had challenges maintaining the road system to safety and environmental standards, resulting in a backlog of deferred maintenance.

Forest trails on the Sierra NF vary in length, topography, and elevation. They support a range of activities, including motorized vehicle use, horseback riding, hiking, mountain biking, snowmobiling, and cross-country skiing. The Pacific Crest National Scenic Trail is the only congressionally designated trail on the Sierra NF. There are five national recreation trails, including Black Rock, Kings River, Lewis Creek, Rancheria Falls, and Shadow of the Giants that have been designated by the Forest Service. The vast majority of the trail system is to standard, largely due to the work of dedicated volunteers.

There is a charter bus to China Peak Ski Resort; however, no other transportation services are available. Members of the public have expressed their desire that transportation is needed to access major recreating areas on the forest.

For information on the number and condition of trails, roads, and other infrastructure that provide recreational access, see Chapter 11 of this assessment.

Scenic Character

Scenic character is a combination of the physical, biological, and cultural images that give an area its scenic identity and contribute to its sense of place. It provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity (36 CFR 219.19).

The Sierra NF is the gateway to the Sierra Nevada, including the heavily visited Yosemite and Sequoia National Parks (USFS 2007a). The forest exhibits diverse and distinctive landscape qualities highly suited to scenic appreciation (USFS 1991a). Research has shown that people prefer more visually complex scenes (Ryan 2005). The forest landscape ranges from steeply rolling chaparral and grass-woodland foothills, to barren windswept crags on the Sierra Crest. The dominant scenery attributes prominent on the forest and essential to its valued image are the lakes and reservoirs that define the lakes recreation niche setting. This setting is also noted for its open, park like conifer and mixed-conifer forests, dominated by large trees, which people tend to have a preference for (Ryan 2005). Other dominant scenery attributes are rivers and streams, wilderness areas, sharp granite peaks, rock outcroppings, and visual access through the forest understory. For information on the diversity of the landscape and scenery attributes, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 498-520.

All forest areas have been evaluated and placed into one of three landscape variety classes: distinctive (A), common (B), or minimal (C) (USFS 1991a, 1991b). About 40 percent of the Sierra NF is classified as distinctive. These mostly high elevation areas are quite varied with many lakes and reservoirs and defined patterns of forest, grasslands, and meadows. About 46 percent of the forest is classified as common, and the remaining 14 percent as minimal. It has been estimated that approximately 74 percent of the common and 57 percent of the distinctive classes are within "sensitive" viewing areas on the forest (USFS 1991b). These are areas where visitors are expected to have a high concern for scenic values and any changes to scenery. The sensitive viewing points identified in the Sierra Forest Plan include, but are not limited to Highway 41, Highway 168 (Sierra Heritage National Forest Scenic Byway), Sierra Vista National Forest Scenic Byway, and developed recreational areas surrounding the lakes and reservoirs. Certain trails, such as the Pacific Crest National Scenic Trail and the Kings River National Recreation Trail, are also considered sensitive viewing points. For more information on variety classes and sensitivity levels, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 521-553.

Scenic character is examined by looking at scenic integrity and scenic stability. The forest's scenic character and valued scenic attributes have an ecosystem context on which they are based. The "Ecological Units of California" by Charles B. Goudey and David W. Smith serve as the frame of reference for assessing scenic character and its scenery attributes, scenic integrity, and scenic stability (Goudey and Smith 1994). The Sierra NF lies within the Glaciated Batholith, Upper Batholith, and Lower Batholith subsections of the Sierra Nevada Section. The Sierra NF's ecosystems are more fully described in the beginning chapters of this assessment report.

Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances from human activities or extreme natural events outside of the natural range of variability (NRV). Scenic integrity uses a graduated scale of six levels ranging from very high integrity to no integrity. Nearly 50 percent of the Sierra NF contains naturally evolving landscapes with limited human intervention. These landscapes are largely wilderness and within the semi-primitive non-motorized ROS class and expected to have very high to high scenic integrity. For the landscapes outside the wilderness and semi-primitive non-motorized ROS class, the Sierra NF is expected to have natural appearing landscapes. Although it is on these

landscapes that development occurs, they are expected to have a high scenic integrity. There are a few areas where developments such as power lines, hydroelectric facilities, transportation systems and ski runs are visual disturbances because they are noticeable and slightly detract from the form, line, color, texture, pattern, and scale of the surrounding landscape. However, other developments contribute to the enhancement of the scenery experience. For example, the hydroelectric facilities have led to the construction of man-made reservoirs. These reservoirs have contributed to the lakes recreation setting. For more information on scenic integrity, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 426-267 and 595-616.

The table below lists the scenic integrity levels and their corresponding scenic conditions on how people perceive the landscape and visual quality objective levels from the Visual Management System.

Scenic integrity levels

Scenic Integrity Levels	Scenic Conditions (How People Perceive the Landscape)	Visual Quality Objective Levels
Very High	Unaltered	Preservation
High	Appears Unaltered	Retention
Moderate	Slightly altered	Partial Retention
Low	Moderately altered	Modification
Very Low	Heavily altered	Maximum Modification

Acres assigned to each Visual Quality Objective on the Sierra NF

Visual Quality Objective	Acres	Percent
Preservation VQO	579,066	41%
Retention VQO	106,791	7%
Partial Retention VQO	264,255	19%
Modification VQO	467,996	33%

Total number of acres within each combination of niche setting and Visual Quality Objective

Niche Setting	Visual Quality Objectives (VQOs)						
	Preservation	Retention	Partial Retention	Modification /Maximum Modification		Niche Setting Acres	% Total Acres
Wildlands	548,831	6403	79985	91,472		751,845	52.5
Lakes Recreation	28,222	50347	27248	25,204		128,359	9.0
Scenic Corridors	1760	29143	75177	61,562		168,954	11.8
Transitional	248	20901	81764	282,318		383,859	26.8
VQO Acres	579,062	106,921	264,290	467,830		1,433,017	100.0
% Total Acres	40.4%	7.5%	18.4%	33%		100%	--

Scenic stability measures the degree to which the valued scenic character and its scenery attributes can be sustained through time and ecological progression. In other words, it looks at the ecological sustainability of the valued scenic character and its scenery attributes. Scenic stability has six levels ranging from very high stability to no stability. Because attributes such as rock outcroppings and landforms change relatively little over time, scenic stability focuses on the dominant vegetation scenery attributes of large trees and diverse vegetation. Although large trees and diverse vegetation are present on the landscape as viewed from sensitive viewing points, they have low scenic stability.

Approximately five percent of the existing vegetation on the Sierra NF is within the natural range of variability (NRV), 64 percent is moderately departed, and 21 percent is severely departed. This is largely a result of forests becoming overly dense from shifted fire regimes due to the exclusion of fire for the past 100 years. Fire regimes in low to mid elevations have shifted from frequent, low intensity ground fires to infrequent, high intensity, stand-replacing fires. At higher elevations, there is an increasing occurrence of high intensity fires (Goudey and Smith 1994). The existing fire return interval is approximately 15 percent within its natural range of variability, 19 percent moderately departed, and 44 percent severely departed. Species composition has shifted from more fire resistant, shade intolerant pine, to less fire resistant shade tolerant white fir and incense cedar. Overcrowded conditions have led to declining tree growth and vigor and increased susceptibility to insect and disease. In addition, the buildup of fuels increases the risk of high intensity, high severity wildfires.

The table below shows vegetation and fire return interval condition within each variety class. Some areas are not assessed because departure from vegetation or fire return interval condition is not applicable. Therefore, totals do not add to 100 percent. An example of this is barren or sparsely vegetated landscapes or areas categorized as non-burnable. Ecosystem stressors such as excessively dense vegetative conditions, fire return interval conditions susceptible to severe wildfire, and insect and disease outbreaks continue to diminish valued scenery attributes, primarily the socially valued large trees and diverse vegetation. For more information on scenic stability, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 9, lines 468-493 and 617-659.

Vegetation and fire return interval condition within variety class

	Variety Class A – Distinctive	Variety Class B – Common	Variety Class C – Minimal	Total
Vegetation Condition				
Class I – Low Departure	1%	3%	1%	5%
Class II – Moderate Departure	22%	33%	9%	64%
Class III – High Departure	7%	9%	5%	21%
Total	30%	45%	15%	90%
Fire Return Interval Condition				
Low to No Departure	11%	3%	1%	15%
Moderate Departure/Insufficient Fire	5%	9%	4%	19%
High Departure/Insufficient Fire	7 %	29%	6%	44%
Total	23%	41%	11%	78%

Visual Management System versus Scenery Management System

In the development of the Sierra NF LRMP, visual resources were inventoried to determine the landscape scenic attractiveness (variety class inventory) and the public's visual expectations (sensitivity level inventory). Based on these inventories, visual quality objectives (VQOs) were established for all National Forest System (NFS) lands. The LRMP VQOs establish minimum acceptable thresholds for landscape alterations from an otherwise natural-appearing forest landscape. The threshold of effects is exceeded when alterations do not meet the visual intensity and dominance criteria of the VQO. Agriculture Handbook Number 462 (USDA-FS 1974) provides the following descriptions of the VQOs specified in the LRMP:

Preservation VQO – Allows only for ecological changes. Management activities, except for very low visual impact recreation facilities, are prohibited. This objective applies to Congressionally-designated wilderness areas.

Retention VQO – Provides for management activities, which are not visually evident. Activities may only repeat form, line, color, and texture, which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, and pattern should not be evident.

Partial Retention VQO – Provides for management activities that remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color and texture common to the characteristic landscape but changes in their qualities of size, amount, intensity, direction, and pattern remain visually subordinate to the characteristic landscape. Activities may also introduce form, line, color, or texture which are found infrequently or not at all in the characteristic landscape, but still remain subordinate to the visual strength of the characteristic landscape.

Modification VQO – Management activities may visually dominate the characteristic landscape. Activities of vegetative and land form alteration must borrow from naturally established form, line, color, and texture so completely and at such scale that its visual characteristics are compatible with the natural surroundings.

Maximum Modification VQO – Management activities of vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background, the visual characteristics must be those of natural occurrences within the surrounding area or character type. When viewed as foreground or middle ground they may not appear to completely borrow from naturally established form, line, color, or texture.

The Forest Plan VQOs, including other visual resources management direction identified in the LRMP were established using the Visual Management System (VMS), Agriculture Handbook (AH) 462 of 1974. In December of 1995, AH 462, *National Forest Landscape Management: Volume 2, Chapter 1: The Visual Management System,* was superseded by AH 701, *Landscape Aesthetics - A Handbook for Scenery Management* (USDA-FS 2009). AH 701 also referred to as the SMS Handbook, presents the Scenery Management System (SMS). In 2007, several refinements to the SMS were distributed for application, as "Appendix J" of the SMS Handbook. This handbook as updated by Appendix J is the basis of the Forest Service Pacific Southwest Region SMS Implementation Process (USDA-FS 2009). Application of the SMS, including Appendix J and the SMS Implementation Process is the "best available science" for scenery management.

This updated SMS represents today's best available science for fulfilling National Environmental Policy Act (NEPA) requirements for use of the environmental design arts to sustain aesthetically and culturally pleasing surroundings (USDA-FS 2008). While most forest land and resource management plans use the VMS of 1974 for scenery guidance, it is recommended that forests begin applying some of the new SMS principles within current projects, particularly those involving vegetation treatments. These new principles include scenery analysis of ecosystem context, existing and desired scenic character, and scenic stability (USDA-FS 2008). With Appendix J, the SMS now contains two indicators for evaluating scenery: *Scenic Integrity*, the established indicator that evaluates visual disturbances; and *Scenic Stability*, a new indicator that evaluates the ecological sustainability of the scenic character people value (USDA-FS 2008).

Scenic character is assessed using the new SMS principles in conjunction with existing LRMP direction. This includes SMS principles and terminology described in the SMS Handbook, Appendix J, and the Forest Service Pacific Southwest Region SMS Implementation Process. Since the LRMP still utilizes the VMS for scenery guidance, the VQOs and variety classes are also used to describe scenic character.

Conditions and trends affecting scenic character

The Sierra NF exhibits diverse and distinctive landscape qualities highly suited for scenic appreciation (USFS 1991b). According to National Visitor Use Monitoring (NVUM) data, the percentage of visitors who participated in viewing natural features increased from 31.9 percent in 2003 to 49 percent in 2007. This increase in scenery appreciation has led to additional travelways and use areas (beyond those identified in the LRMP) from where visitors have concerns for scenic values. Landscape-level drivers that affect scenic character include human-caused visual disturbances such as timber harvesting, road construction, mining, utility corridors, recreation facilities, ski areas, and other special uses (USFS 2007b). Naturally-caused visual disturbances include catastrophic wildfires, insect and disease outbreaks, and wind and ice storms. Natural events that exceed the NRV are considered negative visual disturbances to scenic character, while those within the NRV are considered positive (USFS 2007b). Population growth and urbanization, particularly along the Sierra Nevada foothills, is expected to increase demand for energy and communication infrastructure, which could result in a loss of scenery on Sierra Nevada forests, impacting recreation experiences and sense of place.

Extent to which the Plan Area Meets Recreation Demand and Sustainability of Recreation

Sustainable recreation is the set of recreation settings and opportunities on National Forest System (NFS) lands that is ecologically, economically, and socially sustainable for present and future generations (36 CFR 219.19). To be sustainable, the set of recreational settings and opportunities must be within the fiscal capability of the planning unit, be designed to address potential user conflicts among recreationists, and be compatible with other plan components including those that provide for ecological sustainability. It is the pursuit of recreation on the Sierra NF that allows visitors to interact and learn through interpretation and environmental education presented at nature programs and other recreation venues. Through improved understanding about the forest, these interactions may enhance the sustainability of recreation on the forest and reduce user conflicts.

Population growth in the region is resulting in more people visiting the Sierra NF, which may have ecological impacts. The greatest ecological impacts occur from dispersed recreation, specifically through

the parking and staging of motor vehicles and overnight use. As discussed above, dispersed recreation is increasing as visitors spread to these areas because developed sites are full. Recreational vehicles parked in dispersed areas for extended periods of time cause sanitary concerns, as well as impacts to the land. Dispersed recreation activities often occur near water and vegetation is trampled or cut, soils are compacted, and wildlife habitat is affected. Many visitors are inexperienced with dispersed recreation and may not fully understand forest rules or the impacts of their actions. Increasing population and demand for recreation opportunities may also lead to more conflicts between forest users in the future.

Scenery is a major component of people's recreation experience on the Sierra NF and greatly contributes to their sense of place and ability to connect with the land. Because of the large departure of existing vegetation and fire regimes from the natural range of variability on the Sierra NF, scenic stability is low, reducing the sustainability of scenic character and valued scenic attributes.

Demand is going up for the Forest Service and other land management agencies to provide more and higher quality recreational opportunities. Recreation special use permits are the largest source of fees and receipts paid to the Forest Service for activities on the Sierra NF. At the same time, Forest Service budgets are decreasing and fewer resources are available to maintain and operate existing recreational facilities, develop new opportunities or provide management of dispersed recreation. Funding for recreation including recreation operations, wilderness, special uses, and heritage, has decreased from $1.52 million in fiscal year (FY) 2010 to $ 1.28 million in FY 2013. The budget for recreation facilities has decreased from $190,000 in FY 2010 to $89,000 in FY 2013.

Partnerships, grants, and agreements have increased, helping maintain and improve developed recreation facilities and trails on the Sierra NF. Through hydroelectric licensing, recreation settlement agreements were made with the utility companies to refurbish developed recreation facilities directly related to lakes and reservoirs that draw visitors each year. As a result, recreation facility refurbishment funding has increased substantially. Facility refurbishment funding was $2.66 million in FY 2011 and $1.95 million in FY 2012, much higher than the average $314,000 between FY 2001 and FY 2010. Nine facilities have been refurbished, which has helped the Sierra NF meet visitor expectations. Three facilities are currently being refurbished, and additional facilities are planned for the future.

Contribution the Plan Area Makes to Ecological, Social, or Economic Sustainability

Recreation on the Sierra NF contributes to social sustainability by providing opportunities for people to connect to the land. This in turn, contributes to community well-being and helps people develop a stewardship ethic that can further protect the land and contribute to ecological sustainability. The places that people visit often have emotional meaning that can help define sense of self, as well as social identity. Recreation among other activities on the Sierra NF continues to tie Native Americans to special places that have traditionally been used by their people. The forest also helps visitors make connections with their heritage through its cultural and historical resources. Recreation opportunities on the forest promote social interactions. Being with friends and family is an important reason why people recreate on national forests, and plays an especially large role for certain groups, like the growing Latino population. Outdoor recreation also contributes to human health and well-being by offering a variety of physical and mental health benefits. Eighty-four percent of the Californians polled in the most recent Comprehensive Outdoor Recreation Plan (CORP) statewide survey said outdoor recreation was an "important" or "very important" contributor to their quality of life (Roberts et al. 2009). For more information on how recreation

contributes to social sustainability, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 628-1091.

Public lands can play a key role in stimulating local employment by providing opportunities for recreation. Communities adjacent to public lands can benefit economically from visitors who spend money in the travel and tourism sector in hotels and restaurants, as well as ski resorts, gift shops, and elsewhere. In 2010, these travel and tourism related industries comprised 15.9 percent of jobs in the counties bordering the Sierra NF (U.S. Department of Commerce 2012). Travel and tourism is an important sector in Mariposa County, accounting for 52 percent of employment and 33.4 percent of earnings. These percentages are lower in Madera and Fresno Counties (Dean Runyan and Associates 2012). These counties also receive revenue from sales tax on temporary lodging from visitors who come to recreate on the Sierra NF and other areas. For more information on how recreation contributes to economic sustainability see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 6, lines 1,200-1,235 and 1,296-1,316.

Information Gaps

Sustainable recreation is a relatively recent concept for the Forest Service. As such, there is little existing information that examines this topic. It is very difficult to quantify the effects of dispersed recreation on the landscape. Generally, the effects of use at each individual location are small, but the cumulative impact to ecological integrity is unknown. The Sierra NF does not currently have scenic character of the plan area mapped. addition, little existing data is available for recreation activities that are not tracked in NVUM, such as climbing.

Chapter 10: Energy and Minerals

Important information evaluated in this phase

Available information about the Sierra NF plan area for renewable and non-renewable energy and mineral resources has been identified and evaluated. Energy sources evaluated include hydropower, wind, biomass, and geothermal. Mineral resources evaluated include locatable mineral deposits and mineral materials. This chapter also evaluates Sierra NF abandoned mines and landslide hazards.

Nature, extent and role of existing conditions and future trends

Hydropower

The Sierra NF has a commercial value to the people of California from hydroelectric power and water storage. With increasing populations in the nearby valleys and the need for additional power supplies, opportunities exist to make improvements to existing hydropower projects to enhance power production. These improvements may address localized needs, but will not be sufficient to meet growing demand. No new hydropower projects are anticipated within the planning time frame.

There are a number of planned improvements to existing projects. Improvements to the Balch Project include an installed capacity of 72.4 megawatts. The average annual generation will be approximately 9.8 gigawatt hours per year. The proposed Haas Powerhouse Improvement will result in an increase in

dependable capacity of about 34.6 megawatts and an increase in annual generation of 1.5 million kilowatt hours. The Helms Pumped Storage Project will have an installed nameplate capacity of approximately 1,050 megawatts.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 11-89.

Transmission Corridors for Energy Development

The forest has 14 transmission line corridors totaling approximately 100 miles, and there are no existing or planned transmission corridors (West-Wide Energy Corridor Final Programmatic Environmental Impact Statement 2008 and Record of Decision 2009).

It is highly unlikely that transmission corridors will be developed in the future. The wilderness, wild and scenic rivers, roadless and proposed wilderness areas that run north and south through most of the east side of the Sierra NF make it highly unlikely that a transmission corridor would come through the forests running east or west. Any proposed transmission corridors running north or south would most likely be located in flatter terrain through the San Joaquin Valley (USDA Forest Service 1991b).

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 309-318.

Wind Energy

Currently there is no wind energy being harnessed on the Sierra NF, because there isn't sufficient potential to pursue development. The forest's low wind potential is a result of the inconsistency of wind across most of Sierra NF land. It is unlikely that wind energy will be produced on the forest during the current planning horizon.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 90- 99.

Biomass

Biomass is the biological material derived from living or recently living organisms. It most often refers to plants or plant-derived materials. As a renewable energy source, biomass can be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel. Conversion of biomass to biofuel is achieved by thermal, chemical or biochemical methods. Biomass derived from the forest yields energy through home firewood use and commercial power generation.

Annual firewood permit issuance on the Sierra NF has typically been around 1,500 since 2004. Permits have been split evenly between both Bass Lake and High Sierra Ranger Districts. A slight increase in demand for personal-use fuel wood permits occurred in FY 2010 and 2011, rising to 1,850 permits per year. This demand may be from an increased supply of available material as a result of extreme weather events that killed and damaged vegetation, as well as road hazard reduction projects implemented by the

forest closer to population centers. Most commercial fuel wood volumes are being sold from private lands.

Most vegetation management projects developed on the Sierra NF are beyond the pre-2008 commercial haul radius of 25-50 miles to electrical or ethanol processing plants. Long haul distances and relatively low fuel values limit the cost effectiveness of contracting for forest biomass for fuel production.

Reduction of biomass across the landscape is critical for fuels management and wildlife habitat management across the forest. Using fire to reduce biomass can severely impact air quality in the south and central San Joaquin Valley Air Basin. At this time, biomass is not removed from the Sierra NF unless the activity is subsidized.

In support of a national emphasis on forest restoration and use of low-value material to create renewable energy, the Sierra NF has requested a woody biomass utilization feasibility study to look at the potential of a power plant in partnership with Southern California Edison (SCE). A portion of the fuel supply would be provided as biomass from the Sierra NF and private SCE lands. A study is underway considering a one megawatt wood-fired power plant that would be located in North Fork to provide fuel treatment alternatives on the Bass Lake Ranger District. A one megawatt plant would use half of the tops and limbs from the forest's current annual saw timber program.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 102–122 and 126-139.

Drivers that may Alter Trends in Biomass and Geothermal Energy Developed on the Sierra NF

The Sierra NF has been granted special project funding under the Collaborative Forest Landscape Restoration Act (CFLRA), to develop a series of projects around Dinkey Creek. The project will accelerate restoration treatment on federal and private lands and provide additional funding to meet restoration goals.

Geothermal Energy

While the Sierra NF has warm and hot springs, there are no geothermal resources on the forest. There is no oil, gas and other leasable mineral potential on the forest. It is unlikely that geothermal energy will be produced on the Sierra NF during this planning horizon.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 123 –124 and 140–141.

Mining

Many materials and minerals have been mined on the Sierra NF. Many of these mines have been abandoned. Some minerals and materials still have value and are actively mined. Gold mining on the northern part of the Sierra NF continues by many small operators motivated by current high gold prices. Organizations market their mining claims for recreational gold panning. Tungsten mining has undergone a

severe decline. There are around 20 Notices of Intent to operate a claim submitted each year for prospecting.

For more detailed information on mining see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 143- 212.

Common Variety Minerals

The demand for common variety minerals may increase because of expanding development in the Fresno area. These minerals are most commonly used for building, landscaping, and construction (USDA Forest Service 1988). Mineral laws and regulations do not allow for exploitation of common variety minerals by private entities for outside use. There are exceptions, including the Crane Valley Dam Seismic Retrofit Project, where PG&E requested mining of rock near the dam (Wishon Quarry). These types of situations are difficult to anticipate.

The most recent rock quarry operation is near Bass Lake, where Pacific Gas & Electric Company retrofitted the dam with rock mined on National Forest System (NFS) lands. There are several rock quarries on the forest that have had some reclamation to provide surface water drainage and erosion control.

The Sierra NF also provides free use permits for up to one ton of rock per permit. The two districts manage this resource differently. The Bass Lake Ranger District allows collection of rock material at the Power House 8 Tunnel Muck Site on Forest Road 8S03. The High Sierra Ranger District allows collection of rock material along most roads including existing rock quarries.

Existing and Future Mining Claims

Several claims exist on lands not open to mineral entry because the mining claims were established prior to the area being withdrawn, or the proper process was not followed by the Forest Service to withdraw lands from mineral entry. The Merced River has claims established prior to the river being designated as wild and scenic. The Back Bone Research Natural Area has mining claims established within it after being designated as a research natural area. This area has not been withdrawn from mineral entry. It is unknown if all other areas, such as Forest Service campgrounds and administrative sites have been withdrawn from mineral entry. Most lands within designated wilderness are withdrawn from mineral entry. This includes land within JohnMuir Wilderness, Ansel Adams Wilderness, Kaiser Wilderness, Monarch Wilderness, and Dinkey Lakes Wilderness.

Active Mines

There are two mines with claimants who have contacted the Sierra NF to notify of their intent to conduct mining operations. These include the Williams Brother Mine and Sweetwater Mine. There is one placer claim on the forest in the process of evaluation of a proposal that will be under an operating plan. As long as the price of gold is high, demand for gold prospecting and mining is expected to be high. At this time, there is a moratorium by the State of California on suction dredging that prevents gold miners from mining in streams on the Sierra NF. The suction dredging moratorium is currently planned to expire in

2016. When the state lifts the suction dredging moratorium, it is anticipated that proposals will be submitted to mine placer gold deposits along the major rivers that are open to mineral entry.

Abandoned Mine Lands

There are 491 inventoried abandoned mine lands (AML) on the Sierra NF. Approximately 71 AML sites are located within designated wilderness lands. Approximately 240 of the mines were opened to mine gold. Approximately 111 of the mines were opened to mine tungsten. Approximately 61 of the mines were opened to mine chromium, silver, copper, and iron. There are approximately 49 underground mines, 61 surface operations, 30 placer mining operations, 28 surface-underground operations, and three wells located on the Sierra NF.

For more specific information see the July 2, 201.3 snapshot of the Sierra NF Living Assessment Chapter 10, lines 214-241.

Mine sites have been assessed since 1985 with approximately nine mine sites having been cleaned up or restored. Abandoned mine lands that have been identified as needing work to mitigate physical hazards and remove structures on site include: Rainbow Garnet, Sweetwater, Dinkey Lobo, Weisman and Lucky Blue. Funds to assess, restore and rehabilitate AML are limited and are allocated on a national basis.

Landslide Hazards

Landslides are widely distributed across the Sierra NF. A nearly complete mapping of landslide types was done based on aerial photos taken in 1976. Commonly found landslide types are debris slides, debris flows and rock falls (Varnes 1978). While debris slides and debris flows are present throughout the Sierra NF, rock falls and rock slides are more prevalent in areas with steep rocky slopes like the canyons of the Merced, San Joaquin and Kings Rivers and on the higher elevation slopes within and near the Ansel Adams, John Muir, Kaiser, Dinkey Lakes, and Monarch Wildernesses.

Disastrous impacts from landslides on the Sierra NF are documented as early as 1937 (De Graff 1994). Most landslide impacts are incurred by the road network. Landslides have necessitated costly cleanups, expensive repair or restoration, and indirect costs by denying passage to hydroelectric company employees, timber companies, and recreational users. There are no developed recreation sites or administrative facilities known to be directly impacted by landslides on the forest. Because there has been no systematic evaluation of debris flow, rock fall, or flooding hazard to recreational facilities or administrative sites, the potential for impacts is unknown. To date, there are no recorded instances of fatalities or injuries from landslides on the Sierra NF.

Nearly all of the landslides on the Sierra NF are triggered by precipitation. Precipitation events are more likely to induce debris flows and rock slides from slopes recently burned by wildfires (Cannon 2001, Cannon et al. 2011, De Graff and Gallegos 2012). The effect of wildfire on the vegetative cover and the character of surface soil on burned slopes contribute to their occurrence during the first two to three years following the wildfire (Parise and Cannon 2012).

The likely effect of climate change triggering landslides would be an increase in debris flow and rock fall occurrence. Both of these landslide types can be initiated by intense rainfall. Climate change is expected

to increase the recurrence of high intensity storm events which typically trigger debris flows and rock falls. To the extent that climate change will increase the number and size of wildfires, an increase in debris flows and rock fall will also take place due to the relationship between occurrence of these landslide types and wildfire (Cannon and De Graff 2009).

The anticipated trend for landslides is an increase in impacts. This trend has two components: exposure and occurrence. Exposure represents the number of people, vehicles, infrastructure, and facilities present where landslides may occur. Increased use by the public will raise the potential for landslide impacts. Occurrence is related to the triggering mechanisms leading to more frequent debris flows and rock falls which are fast-moving landslides that travel significant distances from their initiation point. The effect of climate change would indicate a likely increase in these landslide types. Consequently, both exposure and occurrence are expected to contribute to more frequent hazard events.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 10, lines 244- 308.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The Sierra NF supports the development of power through hydropower generation and conversion of biomass to a power source that meets social and economic demands. Electricity has fueled countless technological advances and provides the public more food, deeper mines, stronger metals, modern medicines, and bigger cities. There would be no way to support modern society without electrical power, especially given projected population growth.

Hydropower offers numerous advantages over alternative fuels. Hydropower is:

- Renewable -- the earth provides a continual supply of water from rainfall and snowmelt
- Efficient -- hydropower plants convert about 90 percent of the energy of falling water into electricity
- Clean -- hydropower plants do not emit waste heat and gases
- Reliable -- hydropower machinery is relatively simple, reliable and durable
- Flexible -- units can start up quickly and adjust rapidly to changes in demand

Sierra NF hydropower plants play a key role in the economy by offering an affordable power source, which helps keep overall energy prices down. Without hydropower, the country would have to burn more coal, oil, and natural gas. The increasing availability of hydropower also helps reduce California's dependence on other nations for fuel (Value to the Nation – Hydropower – Army Corp of Engineers, 2013).

Current levels of hydropower generation on the Sierra NF appear to be economically or socially sustainable, although climate change may alter precipitation regimes which may, in turn, affect power generation.

Forest biomass is another potential source of energy to meet the growing demand from increasing populations around the Sierra NF. Current energy production projections from biomass will likely be limited and not on a scale that could support increasing populations. Using biomass, which is a byproduct of ecosystem restoration, as an energy source helps dispose of restoration byproducts while generating a

useful product. The biomass plant under construction in North Fork would help make disposal of restoration-related biomass more sustainable.

The Sierra NF, in accordance with mining laws and regulations provides for mineral development which supports economic and social needs. Without minerals, the public would not have electricity, food, or shelter. Minerals make today's technology-based life possible. The public wants the benefits from those minerals, but some would prefer mining to occur outside their area of interest. The Sierra NF has trained mineral administrators who respond to Notices of Intent and Plans of Operation, and issue permits and contracts for minerals materials. These processes allow the forest to work with mining applicants to make sure the mining is done in a sustainable way.

Information Gaps

Sufficient information exists on renewable and non-renewable energy and mineral resources for an assessment of the condition, trend and social, economic and ecologic contribution to the Sierra NF plan area to be developed.

Chapter 11: Infrastructure

Important Information Evaluated in this Phase

Infrastructure is considered the built property created to support the use of National Forest System (NFS) lands. The five major categories of infrastructure are transportation, recreation facilities, administrative facilities, public utilities, and private uses.

Nature, Extent and Role of Existing Conditions and Future Trends

Transportation

Transportation refers to the vehicular movement of goods and services for the use of the national forest. Roads managed by public road agencies such as states, counties and municipalities which help provide for access to NFS lands are also part of the transportation system. Private roads on private property and private roads under long term Forest Service special use permits are included in the following table. Trails are for the recreational experience, rather than access to an activity, and are displayed under "Recreation".

In 2010, the Sierra NF completed a motorized travel management decision to implement the provisions of the 2005 Travel Management Rule (36 CFR Part 212, Subpart B). This travel management decision designated the road system for the use and utilization of the Sierra NF. The forest is also working to complete Subpart A Travel Analysis in 2013. This travel analysis starts the process to evaluate the sustainability of the national forest road system on the Sierra NF. The forest strategy has been to allow as much access as possible. Road restrictions are only used for site specific reasons and for limited times. For more information, see the July 2, 2013 Sierra NF Living Assessment Chapter 11, lines 122-144.

The forest has three general categories of road: (1) roads seasonally open and maintained for passenger cars, (2) roads seasonally open and maintained for high clearance vehicles, and (3) road closed to all vehicles. These categories are broken down into five maintenance levels.

Maintenance levels

Maintenance Level	Definition	Length (miles)
ML 5	Roads maintained to a high degree of comfort and mobility for passenger vehicles	0
ML 4	Roads maintained to consider comfort and mobility for passenger vehicles.	180
ML 3	Road maintained for passenger vehicles: comfort and mobility is not a consideration	265
ML 2	Roads maintained for high clearance vehicles. Highway vehicles and ATVs are allowed.	1,950
ML 1	Roads maintained to protect investment and adjacent resources. Closed to all vehicular traffic.	410
	TOTAL =	2,805

Maintenance level two (ML2) roads are rough graded and allow use for state permitted off highway and all-terrain (OHV/ATV) vehicles, and by underage operators. Maintenance level three and four (ML3-4) are maintained for highway vehicles and thus OHV/ATV and underage operators are not allowed. A few highway roads have been designated as combined use, which allows OHV/ATV use under state law, but not underage operators. These combined use roads have allowed the forest to provide the OHV/ATV community with interconnected access to most of the Sierra NF.

The forest has approximately 180 miles of double lane paved roads which are considered main line arterials. The forest also has two Forest Service designated national scenic byways (NSB). The Sierra Vista NSB is on the Bass Lake Ranger District and is entirely on NFS roads. The Sierra Heritage NSB is on the High Sierra Ranger District and is entirely on city streets and a state highway.

A condition of the overall road system is difficult to quantify; there are no detailed forest-level road condition surveys. General federal funds for repairing and maintaining roads have decreased approximately five percent each year for over 10 years. The road work done by commercial uses has been reduced by approximately 80 percent in the last 15 years. As a result of these short falls the forest road system has dropped from well maintained at the designated maintenance level to marginally maintained at the designated maintenance level.

Passenger cars roads have more pot holes, and the pavement is not repaired in a timely manner. Maintenance on these ML3-4 roads is for safe access and resource protection. High clearance roads have become much rougher than originally expected. Typically, road maintenance is to remedy watershed or water quality concerns. Much of this road mileage is becoming too brushy for passage. The public's expectation for mobility on national forest roads has been lowered as a result of these constraints.

For more detailed information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 11, lines 53-80.

It is expected that the national forest road system will begin to deteriorate at a faster pace. Direct road maintenance funding has been decreasing for over ten years while recreational uses of the road system

have not diminished. Commercial use of the roads has been reduced by 80 percent over ten years. These commercial interests historically maintained the roads. These limited funds are directed mostly to passenger car roads (ML3-4). Less work is being done on high clearance vehicle roads (ML2).

The ML2 roads are the primary access into forest activities. Recreation access will be reduced as roads become brushed over and washed out. Restoration and vegetation projects will become more expensive as more project funds are diverted to provide for the cost of project access.

Recreation Facilities

A recreation site is a discrete area on a forest that provides recreation opportunities, receives recreational use, and requires a management investment to operate and maintain to standard under the direction of an administrative unit in the National Forest System (NFS).

The NFS trail system has many different types of trails that support a variety of uses, including motorized travel, hiking, bicycling, equestrians, snowmobiles, and cross-country skiing. The table below lists the miles of existing trails on the forest by designed use and trail class. The designed use of a trail indicates that use which requires the most demanding design, construction, and maintenance parameters, and may not be the primary use of the trail. Trail class is the prescribed scale of development for a trail and ranges from minimally developed (trail class 1) to fully developed (trail class 5). Approximately 1,200 miles of trail meet standard on the forest.

Miles of existing trails on the forest by designed use and trail class

Designed Use	Trail Class					Total
	1	2	3	4	5	
4WD		134.85	12.2			147.05
ATV		33.81	1.6			35.41
Cross-country ski		12.8				12.8
Hiking/Pedestrian	74.56	164.69	56.79	8.16	1.04	305.24
Motorcycle		5.62				5.62
Pack and stock	61.31	217.27	228.56	28.1		535.24
Snowmobile			199.7			199.7
Total	135.87	569.04	498.85	36.26	1.04	1,241.06

Maintenance level is relative to the standard relating to the type of use. ML5 trails tend to be 100 percent accessible and tend to be interpretive trails. ML4 trails are designated national recreation trails. ML3 trails provide access to an area or a major pass over the mountains. ML2 trails intersect with ML3 trails to provide access to destinations, camping around a lake for example. ML1 trails do not have any construct features and tend to fade out in some areas.

Facility condition index (FCI) for each recreation site is used as a national performance measure. Recreation sites maintained to standard is the name of the standard. Fifty-four percent of the developed

recreation sites meet standard. The average FCI for all recreation facilities is 0.66. To meet standard the FCI needs to be 0.90 or greater.

Facility condition index information for the Sierra NF

Site Type	Total Sites*	Total Site FCI	Site Performance Rating
Boating site	4	0.9 to 0.999	To standard
Campground	17	0.907 to 1	To standard
Camping area	7	0.979 to 1	To standard
Day use area	2	0.999 to 1	To standard
Group campground	1	1	To standard
Interpretive site	5	0.999 to 1	To standard
Observation site	3	1	To standard
Picnic site	14	0.946 to 1	To standard
Snowplay area	1	1	To standard
Trailhead	16	0.929 to 1	To standard
Boating site	2	0.3 to 0.633	Not to standard
Campground	37	-0.795 to 0.882	Not to standard
Camping area	3	-0.15 to .168	Not to standard
Group campground	7	-0.853 to 0.701	Not to standard
Group picnic site	1	0.72	Not to standard
Info site/fee station	2	0.31 to 0.605	Not to standard
Observation site	2	-1.129 to 0.81	Not to standard
Picnic site	7	-0.825 to 0.799	Not to standard
Trailhead	4	0.542 to 0.889	Not to standard
	135		

*In Chapter 9 of this assessment, the tables show 232 sites; 97 sites have no constructed features and are not included in calculations for FCI.

FCI for recreation sites is based on the following factors: deferred maintenance, buildings, and drinking water and waste water systems. There are 275 buildings, 11 active drinking water systems, 30 septic systems and one municipal sewer system where the forest manages nine grinder pumps. There are 15 sites that access the municipal sewer system.

Partnerships with utility companies are refurbishing recreation facilities around lakes under Federal Energy Regulatory Commission (FERC) licenses. Eleven facilities have been upgraded and improved to standard (seven picnic and four campgrounds). Settlement agreements with the utility companies display several more facilities to be improved to standard. The remaining recreation facilities are stable to decreasing in condition due to lack of funding for repairs. The facilities that are stable tend to be managed by a concessionaire and are maintained. The facilities that are decreasing in condition have no fees being collected to maintain. These facilities receive minimal maintenance.

There are successful partnerships with volunteer groups to maintain trails. Both motorized trails and wilderness trails have benefited from volunteer efforts to maintain and improve the trails. Trails are stable to increasing in condition due to project specific funding, as well as volunteer efforts.

As discussed in Chapter 9 of this assessment, more people are moving to within a one hour drive of recreation opportunities on the forest. There is an increase in the use of developed recreation facilities, and motorized and mountain bike trails.

Administrative Facilities

Administrative facilities are typically buildings and their appurtenances necessary to support the employees, equipment and activities necessary for management of national forests. These are commonly called Fire, Administrative and Other (FA&O). Administrative facilities are separate from recreation facilities. The Sierra NF operates 359 FA&O buildings.

The forest maintains a facilities master plan laying out the status of the FA&O sites and buildings, and the forest's intention into the future. With declining budgets, and correspondingly reduced staff, the Sierra NF has consolidated the number of ranger districts from seven to two. The Sierra NF has also reduced the number of buildings from 425 in 2000 to 359 buildings in 2013. Plans for capital expenditures are focused on rehabilitation or replacement of existing facilities that do not meet current operational standards, and the disposal of those facilities that are now surplus or underutilized. Please see the Sierra NF Facilities Master Plan for more detailed information. The following table displays the summary information from that plan.

Summary information from Sierra NF Facilities Master Plan

Type of Buildings	SO/ FAAB	Bass Lake RD	High Sierra RD	Planned Construction Buildings	Planned Demolition Buildings	Total
Communications	1	8	6		3	18
Barracks		30	19	3	12	64
Residences		12	5		3	20
Industrials		7	15		3	25
Offices	1	5	4		1	11
Other institutional uses		6	10	2	6	24
Services	1	21	14		2	38
Storages		39	46	1	30	116
Warehouses		8	7	1	1	17
All other uses		1	25		1	27
Total =	3	137	151	7	62	360

Over half of the buildings on the forest are eligible, or potentially eligible, for the historic register. The extra cost of maintaining their historic value challenges the budget and skills of the maintenance

personnel. As buildings are deemed to be unnecessary, they are considered for demolition or to be managed as a historic property. However, several buildings necessary for critical mission accomplishments are in advanced decay, one of which is actually recommended to condemnation from use.

It is expected that the facilities budget will continue to decrease, allowing more occupied buildings to fall into disrepair. The combined facilities funding only provides for operations and maintenance. Any rehabilitation or replacement funding has decreased significantly in the last several years. This has resulted in the continued use of unsuitable structures, and an increase in the rate of growth of deferred maintenance. The current deferred maintenance backlog for buildings and grounds is more than $17 million.

Other Forest Service Infrastructure

In order to comply with the National Historic Preservation Act (NHPA) in as efficient a manner as possible, the Pacific Southwest Region of the Forest Service has entered into an agreement with the California Office of Historic Preservation and the Advisory Council on Historic Preservation. Under the agreement, all parties agree once a building, structure, or object reaches 50 years old, it will be considered an historic resource. The Sierra NF has hundreds of buildings that qualify as historic resources.

Currently, there are 431 historic buildings on the Sierra NF. The vast majority of these are administrative buildings built between 1916 and 1962. Most of the historic buildings on the Sierra NF are part of a larger complex of facilities. For example, the North Fork Compound houses the Bass Lake Ranger District administrative complex and is comprised of over 100 historic buildings, structures and objects. Conversely, the Goat Mountain Fire Lookout is an isolated historic building. The larger facilities are made up of groups of buildings that are similar in age and function. The forest manages these as historic districts. The Northfork Compound, Westfall Ranger Station, and the Dinkey Ranger Station Historic Districts are formally eligible for inclusion in the National Register of Historic Places, and the forest is in the process of having the Northfork Compound Historic District listed on the National Register. The Jerseydale Work Center has been determined to be ineligible. Most of the other administrative complexes have not been formally evaluated for eligibility. Therefore, and in accordance with 36 CFR 800 and the agreement, the Sierra NF is required to manage them as if they are eligible properties until a formal evaluation can be completed.

It is not always feasible to maintain and preserve every historic building. Maintenance of buildings that are 50 years old and older can be expensive. Requirements of the NHPA add to the cost and complexity. Many older buildings were constructed of materials that are difficult and costly to acquire today, and the buildings may not be compatible with current technological needs or regulatory compatibility requirements. An historic administrative building may not be functionally useful to the forest, but it may retain qualities that make it desirable to the public.

The recreation rental program is designed to take such historic buildings out of the inventory of administrative facilities and make them available for public rental. Collected rental fees are used for maintenance. The Sierra NF is in the development and planning phase of its recreation rental program for the current inventory of historic buildings. Due to the costs associated with the documentation and rehabilitation of the buildings, the forest is actively seeking external support from volunteers, partners, and non-profit organizations to make this program a success.

Every year, more buildings will qualify as historic resources. The forest's compliance with regulatory requirements and management direction will also increase. Given the current trend toward a decrease in staff and facilities, the forest expects a decreased demand for historic buildings to perform administrative functions. Conversely, the Sierra NF anticipates that the demand for recreation rentals of historic buildings will increase.

Rangeland Infrastructure

Range improvements are designed to improve production of forage, change vegetative composition, control patterns of use, provide water, stabilize soil and water conditions, and provide habitat for livestock and wildlife. The term includes, but is not limited to, structures, treatment projects, and use of mechanical means to accomplish the desired results. This section refers to structural improvements that currently exist within the plan area to improve the range and facilitate livestock management. Permittees are responsible for maintaining all range improvements listed in their grazing permits.

There are many rangeland improvement structures located on the Sierra NF. Examples are range fences, cattle guards, pens, corrals, and water systems. For more information see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 11, lines 255- 266.

Public Utilities

The largest part of the public utility infrastructure is associated with Federal Energy Commission (FERC) licensed hydroelectric systems. For more information, see Chapter 10 of this assessment. In addition, there are a variety of smaller but important utilities with infrastructure across the forest. These include cable TV, telephone and internet service, and municipal sewer service. There are about 62 special use authorizations that approve public utility systems infrastructure on the forest.

More detailed information on public utilities has been added to the Sierra NF Living Assessment Chapter 11. A new snapshot of this information will be taken and posted. Line numbers for this information will be included in the Final Sierra Assessment,

There is a gap between current staffing and the level needed to properly administer the special uses program, including public utility special use authorizations. Currently the Sierra NF has many authorizations for public utility special uses infrastructure that are expired or will expire in the next three years. Historically, forest staff has been unable to keep up with requests by permit holders to reissue expiring permits. Clearing the resulting backlog of expired special use authorizations by 2015 is an agency mandated priority.

Over the last few years, the forest has seen an increase in the number of applications from public utility agencies and local governments to update or replace existing but aging infrastructure. A key factor driving this increase is demand for compliance with new regulations for public health and safety, as well as national security. Much of this new regulation is being enforced by the counties, the state, or federal agencies other than the Forest Service; however, the Forest Service requires that authorization holders demonstrate compliance with all regulations.

Many special use authorizations for communication uses are expired and have been awaiting availability of forest staff for renewal. There is a backlog of new applications for expansion of telephone and fiber optic services. The forest is in the process of renewing existing telephone uses by consolidating them into master permits. The forest expects this trend to remain strong through the next planning cycle due to public demand and presidential and agency initiatives to expand broadband and telephone services in rural areas. Population in surrounding Fresno, Mariposa, and Madera Counties is growing and more people are moving to rural settings and communities adjacent to the Sierra NF. The increase in residential development means increased demand for communication uses.

Processing requests for improvements to existing hydropower infrastructure will continue to be a dominant part of the forest workload. The forest expects a stable to increased number of applications during the next planning cycle for: maintenance activities, upgrades to aging facilities, improvements for more reliable communications, and modifications to implement mitigations required as conditions of re-licensing.

Private Uses

Private infrastructure refers to facilities developed in private ownership used in conjunction with special use authorizations. Such facilities include buildings and other kinds of structures and improvements representing a broad range of permitted recreation and land use activities. These activities can serve single purpose use by individuals or families, as well as offer benefits to the public.

Private infrastructure operated under special use permit can be described under categories of improvements generally similar in purpose. These categories are recreation commercial, recreation non-commercial, community and public information, research/environmental monitoring, agriculture, industry/construction, and encroachments.

There are about 800 special use permits authorizing private infrastructure on the Sierra NF. Seventy-five percent of the facilities fall within recreation categories. The other 25 percent are associated with land uses. The recreation side of the permit spectrum is dominated by recreation residences and resorts. Private domestic water systems are the most common kinds of infrastructure under land use permits. For more information, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 11, lines 267-320.

Demand for national forest land for a variety of recreation and lands special use purposes has seen an increase over the last decade. The increase reflects demographic trends such as growing population and movement of more people to rural settings and communities adjacent to the Sierra NF. These trends are expected to continue into the future. The forest expects that the number of authorizations and the amount of infrastructure will remain stable or show a moderate increase over the next planning cycle. This means that permit holder activities will focus on maintaining and upgrading aging facilities with some modifications to meet increasing demand.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Placed under federal protection and management in 1893 when the area was designated the Sierra Forest Reserve, these lands have met public need for wood, water and outdoor recreation for more than a century. Today, the Sierra NF's many developed recreation areas and its rugged wilderness make it one of the most popular national forests in the United States. Timber management, fuel treatment, access to

private in-holdings, fire control, utility management, special uses, recreation and harvesting of special forest products are among the many opportunities afforded by the transportation system.

The road system on the Sierra NF is the means by which ecological, social and economic environment can be accessed. Roads provide the access necessary to accomplish ecological restoration projects. Roads provide the necessary access for all recreation activities the public enjoys. Roads are the access to power production projects. Local and general state-wide economies depend on access to and over forest lands for such activities as recreation, power generation, private property, range, fiber, and water resources.

The facilities on the forest provide work areas for the workforce administering the Sierra NF. These buildings provide offices for the people charged with directing and implementing sustainability activities. Experts on ecological processes need to be reasonably near the resources to be restored and maintained. The local need to be part of the forest environment is provided by offices being available for information. Recreationists find Forest Service facilities critical for making their experience safe and satisfying. Fire and work centers provide the location for emergency and maintenance resources to be staged from.

The deferred maintenance for road infrastructure on the Sierra NF is approximately $100,000,000 (Sierra NF Travel Management DEIS). The Sierra NF receives approximately $425,000 annually to operate and maintain roads, and the estimated funding needed to maintain roads to standard is approximately $1,600,000 (Sierra NF Travel Management FEIS). Over the past several years, the Sierra NF has had funding to maintain only about 25 percent of its road system to safety and environmental standards.

Information Gaps

Currently data in the Special Uses Database (SUDS) is either missing or needs validation. Crucial data gaps exist related to updating permit holder records to capture inventories of current on-the-ground facilities, as-built site plans, and accurate spatial data. Capital investment information for facilities is also unavailable. A needs assessment, a capacity analysis, and market research to determine if existing private special uses infrastructure is sufficient to meet the public needs are not available. The Sierra NF does not track the amount of water use by special use permit holders. This means there is no baseline data to evaluate the effectiveness of water conservation measures, or for making projections about future demand versus supply. Spatial data related to special uses is either non-existent or frequently inaccurate. There are no gaps in the corporate information for the road system on the forest. There are no gaps in the corporate information regarding the FA&O facilities.

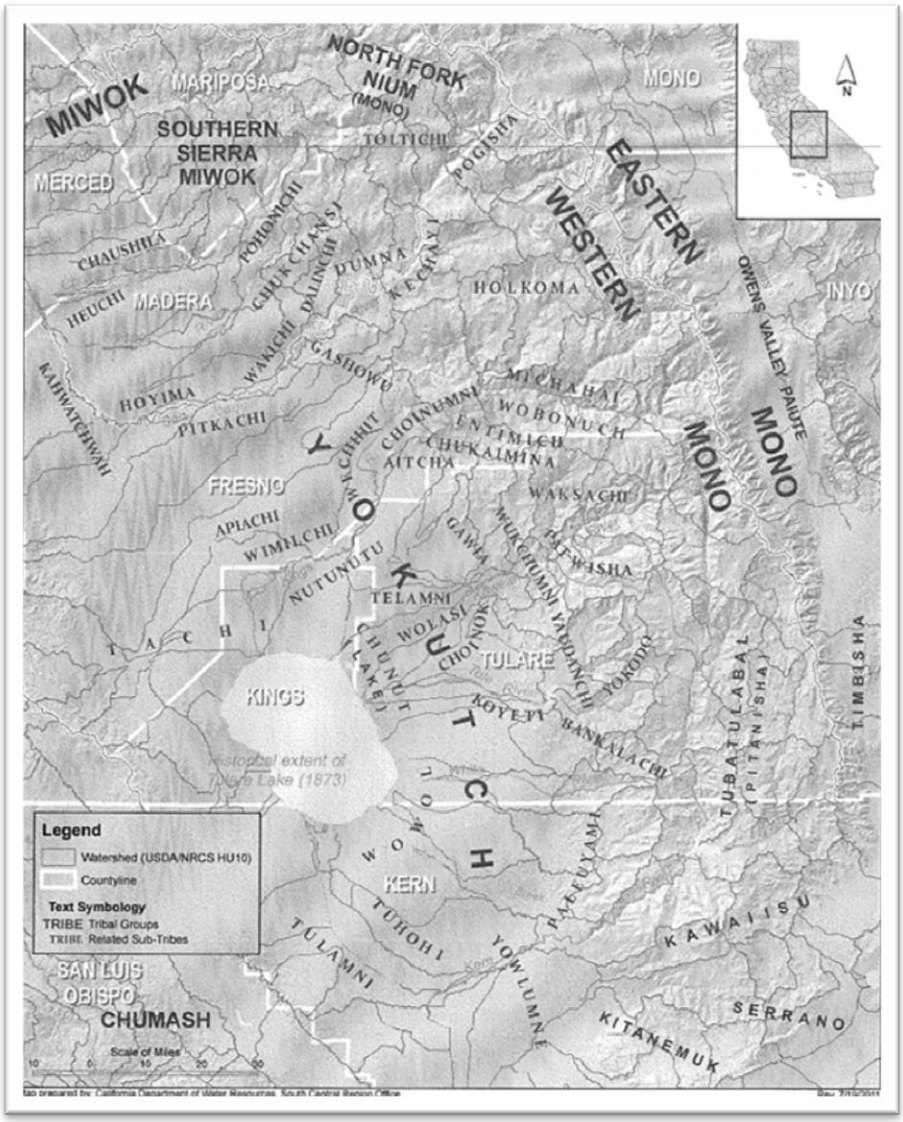
Chapter 12: Areas of Tribal Importance

Important Information Evaluated in this Phase

Indian tribes associated with the plan area, existing tribal rights, and areas of known tribal importance are identified. Existing information was used to assess condition and trend of resources that affect tribal rights and areas of tribal importance. Unless otherwise cited, this information largely comes from the Sierra NFs' tribal program, as described in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 12. Additionally, the section on condition and trend drew heavily from tribal forum notes, individual tribal meetings and consultation meeting notes, regional roundtables and listening session notes, and written comments gathered throughout the forest plan revision process.

Nature, Extent and Role of Existing Conditions and Future Trends

Indian Tribes Associated with the Plan Area



Historic Tribal Groups of the South Central Homeland

Native American people have occupied areas on the Sierra NF for thousands of years. Archaeological evidence and historical and ethnographic accounts attest to the diversity, longevity, and importance that Native American groups have had in this area. The historical tribal groups of the South Central homeland are shown in the map above, prepared by the California Department of Water Resources (2011). Additional ethnographic and tribal territory maps can be found in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 12, lines 468-475.

Tribes associated with the plan area include federally recognized tribes, California Native American tribes that are not federally recognized, and tribal organizations.

Federally recognized tribes:

- Big Sandy Rancheria of Mono Indians
- North Fork Rancheria of Mono Indians
- Cold Springs Rancheria of Mono Indians
- Picayune Rancheria of Chukchansi Indians
- Table Mountain Rancheria

California Native American tribes – non-federally recognized:

- Dumna Wo-Wah Tribal Government
- North Fork Mono Tribe
- American Indian Council of Mariposa (Southern Sierra Miwuk Nation)
- Chaushilla Yokuts
- Dunlap Band of Mono Indians

Tribal organizations:

- Sierra Mono Museum
- The Mono Nation
- Haslett Basin Traditional Committee
- Sierra Nevada Native American Coalition
- California Indian Basket Weavers Association (CIBA)
- Tribal Technical Assistance for Needy Families (TANF) - Owens Valley Career Development Centers (Lake Isabella, Visalia, Fresno/North Fork/Big Sandy Rancheria offices)

Existing Tribal Rights

Native Americans and Alaska Natives are recognized as people with distinct cultures and traditional values. They have a special and unique legal and political relationship with the United States government as defined by history, treaties, statutes, executive orders, court decisions, and the United States Constitution. The policy of the government is to support Native American cultural and political integrity, emphasizing self-determination and government-to-government relationships. Tribal consultation is required by federal law and is reinforced by court decisions, executive orders, and agency policies.

The Sierra NF is responsible for maintaining a government-to-government relationship with federally-recognized tribes and ensuring that forest programs and activities honor Indian rights and privileges. The Sierra NF also confers with non-federally recognized tribes, organizations and individuals. Existing tribal rights related to the plan area include water rights, native plant gathering rights, and hunting and fishing rights. In addition, cultural spiritual sites are also protected.

For more information on tribal rights, and associated laws and policies, as well as roles and responsibilities, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 12, lines 9-40, 153-177 and 256-384.

Different types of agreements are used to strengthen and enhance relationships with tribes. Currently, the Sierra NF has one agreement in place with the North Fork Rancheria of Mono Indians. This Memorandum of Understanding (MOU) formally recognizes the government-to-government relationship. It outlines a framework for cooperation between the agency and the tribe to carry out their separate activities in a coordinated and mutually beneficial manner. While other tribes have expressed interest in similar agreements, and the forest has promoted their development, no formal negotiations have taken place. The Sierra NF also has a DRAFT Sierra NF "Protocol for the Inadvertent Discovery and Identification of Native American Human Remains, Funerary Objects, Sacred Objects and Objects of Cultural Patrimony". This applies to federally and non-federally recognized tribes. The forest has an MOU/Special Use Permit with the Haslett Basin Traditional Committee (Holkoma Mono) for the Haslett Basin area on the High Sierra Ranger District; an MOU with the Mono Nation for use of the Mono Hot Springs Campground area for the Annual Gathering. The North Fork Mono Tribe also has a partnership with the Bass Lake Ranger District for use and care of the Crane Valley Meadow Restoration project.

Areas of Known Tribal Importance

Identifying and evaluating areas of known tribal importance in the plan area or affected by management of the plan area is a challenging concept, given the tight bond between tribal people and the land. Fundamental to their social consciousness is the belief that they are tied to the land by a pledge that they will tend to the resources and comply with traditional instructions, and in return, the land will nurture them. The indigenous peoples of the Sierra NF have an unbroken union with the area that has survived for at least 14,000 years. Thus, the rivers, mountains, and meadows seen on a map are as familiar to them as the items in your living room are to others. Tribal people are as concerned about impacts to those areas as others might be if someone were to vandalize or destroy or take their furniture.

One way to better understand areas of tribal importance is to classify them according to the following social institutions:

- *Family: areas important for defining and understanding kinship.* Many areas on the forest are important for these purposes. A very limited list of examples include: the Merced River canyon, San Joaquin River drainage, Kings River drainage, Merced River/Ferguson rock slide area, Mono Hot Springs, Jackass Meadow, Haslett Basin, Huntington Lake, Shaver Lake, and Bass Lake.
- *Government: areas important for defining and understanding political boundaries and the political structure of tribes.* These include identified tribal aboriginal territories, rivers, rancherias, reservations, tribal allotment lands, trust lands, and tribal lands that were converted to fee lands.
- *Economy: areas important for gathering and distributing wealth and resources*. These include sedge beds, sour berry patches, meadows, elderberry patches, black oak groves, river mussel beds, fisheries, and hunting grounds. In terms of trade, areas of tribal importance include trails and areas where acorns, pine nuts, obsidian, and materials for beads, baskets, clothing, and tools are currently collected and have been for generations.

- *Education: areas important for training and transferring knowledge about traditional practices.* These include areas such as campsites, trails, bedrock mortar/milling stations, fandango grounds, sweat lodges, village sites, and gathering sites.
- *Religion: areas important for spiritual power and religious activities.* These include ceremonial areas, vision quest areas, burial grounds, sweat lodges, Bear Dance sites, Ghost Dance sites, meadows, granite domes, peaks, rock art, waterfalls, potholes/pools, caves, and rock shelters.

Conditions and Trend of Resources that Affect Tribal Rights and Areas of Tribal Importance

Federally recognized tribes, along with other local tribes, groups, and individuals who have not been federally recognized, look to the Sierra NF for traditional and contemporary uses and currently consider it part of their ancestral homeland. With open space around the national forests disappearing because of population growth and urbanization, the Native American community will increasingly look to the national forests to meet their needs for traditional foods, plants, and places of solitude to conduct traditional activities. Tribes are concerned about the protection of, and access to resources of cultural or traditional importance and areas with special or sacred values, often the locales of ceremonial activities. This includes use of Forest Service roads that access rancheria lands, protection of the Merced, Willow Creek, San Joaquin and Kings River watersheds, and protection of rancheria and allotment lands from fires that start in the forest.

The following issues related to water resources affect tribal rights and areas of tribal importance and are expected to continue to be issues in the future: conflicts between tribal and Sierra NF reserved water rights, water-based recreation activities infringing on areas used for ceremonies, and the lack of information on areas of spiritual significance causing misunderstanding about how and where to manage vegetation. Because information is often culturally sensitive and confidential, tribes often do not disclose locations of sacred or spiritual areas to protect and preserve them. With the expected increase in uncharacteristically large fires, as well as impacts from climate change, tribes may end up needing to establish new sacred sites or ceremonial areas in the future (Goodwin 2013).

Tribal gathering is currently and will continue to be affected in the future by climate change, competitive uses on the forest, increasing recreation demands, grazing, altered fire regimes, ability to do traditional burning and management, agency fuels and vegetation management, and non-native species. Gathering may be impacted if tribes cannot access plant materials outside known gathering areas. Tribes continue to find new sources of plant material during their gathering processes or during Forest Service project implementation.

Tribes are concerned about the safety of routes off rancherias through public lands using Forest Service roads. Many indigenous trails are still used by tribes, such as the Mono-Paiute Traditional Sierra Walk, and this use should be considered in forest management.

Forest Service road maintenance, construction, and decommissioning have impacted tribes positively and negatively. There is currently a tension between these positive and negative effects. Upgrading a road may facilitate and increase access to areas of tribal importance. At the same time, improvements can also diminish those qualities held to be sacred or culturally important and can potentially introduce traffic into areas used for ceremonies. Limiting access can protect cultural resources, but may impact other forest

users. Decommissioning roads can negatively affect areas of tribal importance when roads are eliminated that are themselves cultural resources with important historical associations. The ground disturbance associated with decommissioning can disturb archaeological deposits on or near the road. At the same time, reducing access can also prevent vandalism and damage to cultural resource sites.

Sierra NF consultation with tribes has helped and continues to help resolve this tension. Overall, tribal relationships with the Sierra NF have improved as a result of increased consultation and collaboration. Resolving these tensions in addition to other issues through tribal consultation and collaboration on projects will continue to be an ongoing process. Furthermore, there has been increasing collaboration with Forest Service scientists in order to better incorporate traditional ecological knowledge into their work, for example, with black oak. At the same time, decreasing federal budgets and resources available for the tribal program will make efforts to work with tribes increasingly challenging in the future. Personal, face-to face interaction with tribes is vital to developing strong relationships with tribal communities and to having successful consultation.

Scenery management on the Sierra NF is important to tribes. The Native American community feels a close association with cultural and historic landscapes. Any activity that promotes scenery management and aims to maintain the feeling of the natural-appearing landscape has a beneficial effect. Any alteration or permitted degradation of scenic integrity from the more natural settings or the settings associated with the cultural resources may affect cultural or historic landscapes or traditional cultural properties. Because of the large departure of existing vegetation and fire regimes from the natural range of variation on the Sierra NF, scenic stability is low. See Chapter 9 of this assessment for more information on scenery management.

Impacts of recreation to local tribal cultures need to be taken into account as well. Tensions are growing among American Indians and those using and managing the outdoor recreation resources of the West (McAvoy 2002). The agency is required by law to administer the National Forest System for outdoor recreation, among other uses including range, timber, water, wildlife and fish. Untold numbers of Native American sacred sites and traditional places are located on these same lands, and tribal practices are tied to these resources. Economic and recreational drivers are important in land management decision-making. Sacred site concerns are equally important. American Indians are part of the old and the new west. They have historic, contemporary and symbolic links with the landscapes of the west, including the landscapes in and near the major recreation, park and tourism resources. Increasing user visits or directing recreational or user traffic toward sacred sites or traditional cultural properties may have an adverse effect on the location, as well as the religious, ceremonial or cultural activity of the tribes (Goodwin 2013).

Reburial requests from several federally-recognized tribes on the Sierra NF have been increasing since the Food, Conservation, and Energy Act of 2008, Subtitle B – Cultural and Heritage Cooperation Authority (the Farm Bill of 2008. The Forest Service was given authority to honor these reburial requests received from tribes on ancestral Forest Service lands. There is ongoing coordination between tribal representatives and forest officials to identify and designate locations on National Forest System (NFS) lands. This will lead to new areas that may be impacted by forest management activities. Additionally, many of these sites are extremely sensitive and tribes do not want their locations known.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

The plan area contributes to social and economic sustainability by helping to maintain Native American culture, traditions, and lifeways, which are deeply connected to the land. Forests in the entire Sierra Nevada bio-region play an important role in supporting and protecting the rights and privileges of tribes that help them maintain their culture. Every national forest is carved out of ancestral Native American land, and Native American historical and spiritual connection to the land has not been extinguished or diminished despite these changes in title. For thousands of years, their land use ethic included spiritual, philosophical, and economic dimensions (Anderson and Moratto 1996). Many Native Americans participate in traditional activities, such as hunting, fishing, trapping, and gathering berries, and do not differentiate these activities into distinct categories, such as work, leisure, family, culture, and tradition (McAvoy et al. 2004). These activities carry on family and tribal traditions, provide sustenance for families, and continue a spiritual connection to the land and to animal and plant resources (McAvoy et al. 2004). These activities, and the places connected to them, have cultural, symbolic, and spiritual as well as functional meanings (McAvoy et al. 2004).

The relationship between tribes and the Sierra NF is also important in contributing to ecological sustainability through the management and restoration of ecosystems. Because social, economic, and ecological aspects of life are so integrated within Native American culture, many of the ecological benefits of working with tribes can also have social and economic benefits for tribal communities. In Native American culture, humans are viewed as part of the natural system, helping to ensure abundance and diversity of plant and animal life (Anderson and Moratto 1996). Native Americans practiced land management though burning, irrigating, pruning, selective harvesting, sowing, and weeding. The removal of Native American management from the landscape has influenced and continues to influence Sierra Nevada forests. Resource management by Native Americans in the Sierra Nevada bio-region was long term and widespread, producing ecological and evolutionary consequences in the biota (Blackburn and Anderson, as cited in Anderson and Moratto 1996). Therefore, many ecosystems in the Sierra are not self-maintaining islands that require only protection to remain in a "pristine" state. There is currently an ecological "vacuum," or disequilibrium, in the Sierra Nevada resulting from the departure of Native Americans from managing these ecosystems. The decline in biotic diversity, species extirpation and endangerment, human encroachment into fire-type plant communities like chaparral, and greatly increased risk of catastrophic fires are thought to be symptoms of this disequilibrium.

Tribal communities within the Sierra Nevada present distinctive opportunities for mutually beneficial partnerships to restore ecologically and culturally significant resources, and to promote resilience (Charnley et al. 2013). Lessons learned over thousands of years can help us develop long term strategies to restore the nation's forests. Traditional ecological knowledge and western science can be blended for successful outcomes on the landscape. Tribes can also be supportive partners for management decisions. Tribal partners can facilitate larger collaborative efforts between federal agencies. Tribes work with nearly all state and federal agencies, and have access to private funding and their own programs. Recognition of their strength as partners can help accomplish landscape-scale restoration. In addition, working with tribes can provide them with more opportunities to be direct stewards of the land, which is a vital part of Native American culture. Active participation in forest management activities can also create jobs and improve economies in tribal communities.

Information Gaps

Limited existing information is available regarding condition and trend of resources that affect tribal rights and areas of tribal importance. Part of this is due to the nature of areas of tribal importance. Many of these areas are sensitive or sacred, and tribes wish to keep these areas confidential in order to protect them. In addition, the Sierra NF continues to learn about tribal culture and values, as well as traditional ecological knowledge. As discussed further in the next chapter, the current expanded definition of cultural resources includes categories of resources extremely important to the sustainability of tribal culture but that were traditionally viewed as "natural," so additional categories of sites, districts, and cultural landscapes likely exist but have yet to be identified and evaluated.

Chapter 13: Cultural and Historical Resources and Uses

Important Information Evaluated in this Phase

In this chapter, cultural and historical context of the Sierra NF is examined and cultural and historic resources present in the plan area are identified. Existing information is used to assess the condition of these resources, including historic properties in the plan area identified as eligible or listed in the National Register of Historic Places and designated traditional cultural properties. Trends that affect these conditions or demand for these resources are also assessed.

Unless otherwise cited, this information comes from the Sierra NFs' Heritage Resources Program, as described in the July 2, 2013 snapshot of "Chapter 13: Assessing Cultural and Historic Resources and Uses – Sierra NF" from The Living Assessment. For more details on internal and external information sources used to develop the Living Assessment, see the Sierra NF Chapter 13, lines 578-612 and 802-824.

Nature, Extent and Role of Existing Conditions and Future Trends

Cultural and Historical Context

Prehistoric Period

The Sierra NF has been home to Native Californian people for at least 13,500 years. Early inhabitants had a primarily nomadic lifestyle and traded and manufactured stone tools and materials. The period from 10,000 to 1,500 years ago marked a shift in to a warmer and drier environment, bringing about changes to vegetation communities from conifer forests and grasslands, to deciduous forests and expansion of brush species more suited to dry environments. Almost all the larger mammals went extinct during this period. Human adaptations to these changing conditions included a shift in weaponry and a dramatic increase in ground stone tools, suggesting an increased dependence on plant resources. Toward the end of this period, coastal and Sierra Nevada cultures shifted toward a more focused subsistence strategy, increasingly complex social organization, and larger and more permanent settlements. Around 1,500 years ago evidence of bow and arrow weaponry began to appear, marking the beginning of a new period in California human history that then ended with the arrival of European settlers in North America about 500 years ago. This marked the end of the prehistoric period.

Historic Period

The traditional paradigm places Native American cultural resources within the prehistoric period described above, and European, Asian, and African American cultural resources within the historic period. That paradigm has proven to be false and has excluded Native American contributions to the broad scale

of events that have shaped this country during the historic period. Though they were forced to relocate, the indigenous people of the Sierra NF were never entirely removed from their traditional homeland.

Europeans made contact with local indigenous peoples roughly 500 years ago. Between Spanish occupation of California starting in 1769, and the formal removal of the indigenous population from their ancestral territories by the mid-19th century, many traditional cultural practices and materials continued to be used, There is marked evidence of European trade items and direct effects of disease, displacement, and conflict are also evident. Active Spanish occupation and colonization of California was marked by the construction of missions and presidios along the coast, and by the forced enslavement of indigenous people. In the early 1820s, Mexico won its independence from Spain. California was eventually transferred to the United States in the 1848 Treaty of Guadalupe Hidalgo. Forced subjugation of indigenous people increased, and armed resistance by Native Californians escalated. The period from the mid-19th century to the present began with conflict and warfare and was marked by displacement, political and social discrimination, and institutionalized attempts to erase the Native Californian cultural identity. The historic period has typically been described in the context of mining, logging, ranching, hydroelectric infrastructure, and the Forest Service. At this point, Native American contributions to these histories are not evaluated separately. This is likely to change in the future as research and tribal consultation continue.

The Gold Rush of 1849 likely affected the area and its inhabitants in similar ways to the rest of California, though relatively little gold was found. One of the earliest commercial enterprises in the Sierra was sheep ranching, which grew exponentially in California from the 1870s through the 1890s. Many of the trails that herdsmen used became wagon roads and eventually developed into a crude road system connecting Sierra settlements. By the 1890s, the western slope of the Sierra was divided into informal ranges recognized by stock companies.

Perhaps no other industry played a larger role in the socioeconomic development of the region than logging. From the late 1880s into the 1930s, logging was the lifeblood of the towns and communities in Mariposa, Madera, and Fresno Counties. In addition to railroads, an extensive system of flumes was constructed to bring logs from the mountains to the Central Valley mills.

The river systems of the area were first recognized for hydroelectric potential in the 1890s. By the early 1900s, financial syndicates and power companies had been established to harness this resource and provide energy to the growing needs of the American public. By 1911, some of the world's most powerful hydroelectric generating plants were built, leading to huge industrialization of the San Joaquin River and Kings River watersheds. This great expansion continued into the 1960s and can be seen in the reservoirs at Bass Lake, Mammoth Pool, Huntington Lake, Florence Lake, Lake Edison, Courtright Lake, and Wishon Reservoir.

In the 1860s, the U.S. government began to directly regulate the use of the area that is now the Sierra NF. In 1891, the Forest Reserve Act was passed, which established forest reserves to conserve the nation's timber and water resources. On February 14, 1893, the Sierra Forest Reserve was created, later becoming the Sierra NF with the creation of the U.S. Department of Agriculture Forest Service in 1905.

By the late 19th century, many tourists and adventurers were coming to the Sierra NF to recreate. In 1897, the Organic Administration Act was passed, establishing permits as the means by which forest resources were to be allocated and used by private parties. Permits not only created a new source of revenue, but expanded public use of the forest through new opportunities and development. A hallmark of the depression in California was use of Civilian Conservation Corps (CCC) labor on the national forests. An

enormous amount of work was accomplished on the Sierra NF in the eight years following the establishment of CCC camps in 1933. Much of the Forest's current infrastructure, including roads, trails, campgrounds, telephone lines, and buildings, was built by the CCC. In the latter half of the 20th century, foot travel in the high Sierra exploded in popularity. Surplus equipment from World War II became used for recreational backpacking during the economic boom that followed the war. In addition, European hiking traditions found their way into American markets. In 1964, the Wilderness Act was passed in recognition of the undeveloped character of the high Sierra and the value of preserving this character for the American people. The Ansel Adams and John Muir Wildernessess were established on the Sierra NF. Today the Forest is recognized for over a century of providing for the public needs of wood, water, electricity, and recreation.

For more information on cultural and historical context see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 13, lines 35-289.

Cultural and Historic Resources Present in the Plan Area

The Forest Service currently defines "cultural resources" as:

> An object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties (FSM 2300, Section 2360).

Consultation with Indian Tribes and Native American groups has recognized the need to expand this definition to include categories of resources traditionally viewed as "natural" as opposed to "cultural." Plants, animals, and water, which provide major contributions to the economic and social sustainability of their culture, are viewed as "cultural resources", in addition to the artifacts, features and sites that comprise the remains of their aboriginal occupation and use of the land. Incorporating this perspective into cultural resources management practices and policies is an evolving process, and will likely lead to identification of additional types and categories of sites and districts, as well as cultural landscapes in the future.

The Sierra NF has 4,291 known cultural resources that it manages and tracks. The vast majority of these cultural resources are sites. There are 3,323 prehistoric resources, which comprise 78 percent of all cultural resources. All Native Californian resources are currently classified as prehistoric, although this classification is not entirely accurate, as discussed above. Historic resources refer to those typically associated with mining, logging, ranching, hydroelectric infrastructure, and the Forest Service. There are 696 historic resources on the Sierra NF. There are 164 multi-component resources, referring to those with both Native Californian and historic period cultural material and features. Of the total known cultural resources in the plan area, 108 have not been identified and classified. There are 431 historic administrative buildings located on the Sierra NF.

Ethnographic resources are cultural resources that the forest has not been tracking. These resources represent places that manifest one or more attributes of natural resource extraction, spiritual significance, or social and religious ceremonial activity. There locations are frequently guarded secrets of the tribal community and considered confidential. The forest manages these cultural resources for the benefit of the

Native Californians as part of the trust responsibility for the tribes. Examples of types of ethnographic resources include:

- **Traditional Cultural Properties (TCPs)**: Placed-based resources that achieve their significance more by their importance to the affected community than by their association with historic events or persons. The Sierra NF currently has knowledge of 10 Traditional Cultural Properties. The Mono Trail Corridor TCP is currently nominated for listing in the National Register of Historic Places. One additional TCP was recently identified within the Merced Wild and Scenic River corridor and is associated with the Southern Sierra Miwuk Nation tribal community. Two additional resources have been identified for consideration as TCPs through tribal consultation with the Chukchansi and Holkoma Mono tribal communities. A recent ethnographic study of cultural resources in a Federal Energy Regulatory Commission (FERC) license area on the Sierra NF has identified six new TCPs for the Chukchansi and Nuim Mono tribal communities. A majority of these six areas is on Sierra NF lands.
- **Traditional Gathering Areas**: Specific locations on the landscape that are used by Native Californians to collect traditional foods, fuel, medicine, and art and crafts material. The location of gathering areas is generally kept confidential by tribes. Only seven traditional gathering areas have been formally identified for management purposes.
- **Spiritual Places**: Locations that achieve their sacredness by association with a spiritual entity or those places where activities occur that are themselves sacred or religious. Native Californians view all things as imbued with spiritual identity, so at the broadest level, the scope of spiritual or sacred places would include just about everything. This definition is not meant to disregard the belief that all things and all activities are spiritual, but rather to identify locations of paramount importance to the tribes for the purposes of this assessment. Through tribal consultation, the Sierra NF has identified that spiritual places include, but are not limited to: water courses, hot springs, geologic features, burial grounds, rock art sites, specific archaeological sites associated with creation stories, and places of past and current religious ceremonies. The forest manages these resources under a combination of strategies that include special uses permits, priority heritage assets, and collaborative activities.
- **Traditional Trails**: System of aboriginal trails that connected Native American settlements. They were important for trade, transportation, and social and cultural exchange. Only a small number in the expansive system have been identified. Presently, the Mono Trail Corridor TCP is the only one that has been recorded and evaluated.
- **Historic Districts**: Areas comprised of multiple properties that are usually thematically and spatially associated. A few examples include: recreation residence tracts, Forest Service administrative sites, clusters of Native Californian habitation sites, and abandoned historic railroad logging systems. The Sierra NF has identified 27 historic districts, but this number is increasing as management strategies evolve.
- **Cultural Landscapes**: "A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values," as defined by the National Park Service. This is a relatively new concept for the Sierra NF, and to date, only one cultural landscape has been identified. The Merced River Cultural Landscape is located within the boundaries of the Merced Wild and Scenic River between El Portal and Briceburg, California. It includes a built environment representative of the late 19th to early 20th century, as well as Native Californian resources.

For more detailed information on ethnographic resources, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 13, lines 318-406.

Many areas of the Sierra NF have not been inventoried for cultural resources. These are primarily remote areas, like wilderness. It is estimated that about 7,000-10,000 cultural resources are located in the plan area.

Condition of Known Cultural and Historic Resources

The National Historic Preservation Act of 1966, as amended (NHPA), identified the responsibilities of federal agencies for historic preservation, and established the process and requirements for evaluating significance of cultural resources. Additionally, it directed the Secretary of the Interior to create a National Register of Historic Places (NRHP). Within the guidelines of the NRHP, cultural resources are: eligible for listing on the NRHP, not eligible for listing, or have not been evaluated. Those resources that have not been evaluated are treated as if they are eligible for listing until such time as a formal evaluation is completed.

For more information on the NHPA and NRHP, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 13, lines 418-433. Other major laws that impact cultural resources management on the Sierra NF include the Wild and Scenic River Act of 1968, Archaeological Resources Protection Act of 1979, and Native American Grave Protection and Repatriation Act of 1990. For more information on these, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 13, lines 459-537.

The information provided here is based primarily on a data pull retrieved from the Forest Service INFRA database on 11/05/2012. This information has been augmented where appropriate with recent data from the forest Heritage Resources Program records. There are some minor quantitative discrepancies between the information in the INFRA database and the more accurate data housed on the forest due to the lag time between data collection and INFRA entry.

Approximately 94 percent of all cultural resources on the forest have not been formally evaluated for NRHP eligibility.

Three percent have been determined to be eligible and 3 percent have been determined to be not eligible for listing. The only property on the forest currently listed on the NRHP is the Dinkey Creek Bridge. Two additional properties are under evaluation and review. The Mono Trail Corridor Traditional Cultural Property is in the nomination process, and the North Fork Compound Historic District is in the pre-nomination phase of the process.

An important part of managing cultural resources is identifying their condition. The existing condition of the resource affects its significance under the NHPA, its listing on the NRHP, and identifies what actions need to occur in order to maintain, protect, and interpret it. The NHPA requires that the forest monitor and record the condition of cultural resources in order to ensure their sustainability, and to identify and report adverse effects.

Of the total 4,291 known cultural resources on the Sierra NF, disturbances have been observed for approximately 14 percent of them. Only 429 cultural resources have been assessed for their condition.

About half of these are in good or excellent condition. Another 41 percent are in fair condition. The remaining 9 percent are in poor condition.

Trends Affecting Condition of Cultural and Historic Resources or Demand for these Resources

Historically, the Sierra NF has viewed cultural resources through the framework of legal compliance with Section 106 of the NHPA. Consequently, agency direction has focused on avoiding direct physical effects to cultural resources, and ensuring confidentiality of their locations. Under this system, cultural resources were well-defined features and objects that fit reasonably into a material context of stone, bone, metal, and glass, and a prioritized qualification system of "eligible" or "not eligible" for the National Register. Recently, Forest Service direction has undergone a major shift in philosophy due mainly to the increased promulgation of law, regulation, and policy. Additionally, in 2010 the United States fully endorsed the United Nations Declaration on the Rights of Indigenous People. Many of the new laws, regulations, policies, and resolutions deal with Native American definitions and uses of cultural resources. This means that the agency is now entering unchartered waters for those types of cultural resources that it has not previously managed. Therefore, there is little to no qualitative or quantitative information about trends that affect their condition or the demand for their use. Some general, overarching trends that are driving change over the next 10-20 years and beyond are: climate change, increasing wildfire risk, population growth, increasing demand for recreation and heritage tourism, increasing illegal activities on forests, increasing demands by California Native American tribes for access to and use of traditional and sacred cultural resources and places, decreasing federal budgets, and declining economic viability of rural America.

For more detailed information on trends, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 13, lines 613-801.

Climate Change and Wildfire

The climate of North America in general and the southern Sierra Nevada in particular has been warming since the middle of the 19th century. This warming trend will likely continue for some time. The effects on cultural resources vary with the type of resource. Generally, warmer and drier climatic regimes produce changes in the vegetation community. Noticeably, conifers tend to die off, while oaks and chaparral species thrive. With the decrease in moisture, there is an increase in wildfire and subsequent erosional activity.

Current management direction to avoid cultural resources during fuels treatments and timber removal activities has led to some unexpected adverse results, namely unnaturally dense vegetation growth on archaeological sites. The Sierra NF, in an effort to avoid impacting cultural resources, has excluded archaeological sites from fuels and vegetation treatments for approximately 30 years. This policy of protection has allowed vegetation to grow unchecked on these sites, while the surrounding area has been treated. This concentrates fuels on these cultural resources. If this management direction continues, these cultural resources are more likely to experience adverse effects due to higher intensity burns during wildfires, difficulty accessing areas for traditional gathering and ceremonial activities, and impacts to the integrity of setting of properties eligible for listing in the NRHP.

The effects of wildland fire suppression on cultural resources are different from the effects of wildfire. Suppression activities have two components that adversely affect cultural resources. The first component, physical ground disturbance, directly impacts cultural resources by removal and alteration of the physical integrity of design, materials, and setting. These impacts are potentially destructive to all categories of cultural resources. The second component, the application of aerial retardant, introduces potentially toxic chemicals and dyes into the environment. This type of suppression activity primarily impacts plant and water cultural resources, as well as petroglyph/pictograph and sacred sites. The Sierra NF has not experienced the number of catastrophic wildfires that other forests have; however, with the climate warming, this is likely to change. Trend analysis for the next 10-20 years indicates an increase in the frequency and severity of wildfire in the Sierra Nevada. Current management direction deals with impacts to cultural resources from suppression activities through an effective system that documents those impacts and mitigates their effect. What is missing is the recognition of many of the Native Californian resources as cultural resources, and an agreement document with our tribal partners for what mitigation measures would be acceptable. If current management direction continues for the next 10-20 years, there is an increased likelihood that significant Native Californian cultural resources will be adversely affected with little to no documentation and mitigation.

Population Growth, Recreation, and Heritage Tourism

Recreational use has both positive and negative effects on cultural resources. Population growth in the central San Joaquin Valley has increased sharply over the past 20 years with no indication of a decline in the future. The area's largest city, Fresno, is California's fifth largest metropolitan area, and remains the poorest in the state and the second poorest in the country. This is based on the number of people living below the poverty level. As the population grows in gateway communities adjacent to the Sierra NF, demands for recreation, especially local, low-cost recreation, increases. While cultural resources are impacted by a variety of activities, direct physical damage is generally the most destructive. Many existing recreational facilities are currently located on or near cultural resources. Increased use and demand by a growing population may require the expansion of existing infrastructure. More people and infrastructure could lead to more adverse effects on cultural resources. As demand for recreation increases and agency budgets decrease, the Sierra NF will be challenged to meet its legal mandate to protect and preserve these non-renewable resources.

On the other hand, as population in the area increases, so has the interest that the public and the tribes have in the management and interpretation of their heritage. Over the last three years, heritage volunteerism has witnessed an exponential leap from around 100 hours to approximately 8,000 hours. This increase is due in part to programs like the California Archaeological Site Stewardship Program, and Passport-in-Time, as well as active engagement with the public and tribes. The heritage resources program can play a critical role in enhancing the socioeconomics of local communities and the benefits to tribal, state, and local partners.

The concepts of heritage tourism or cultural heritage tourism have developed in response to the recognition that people like to visit heritage sites, and experience different cultures while vacationing. Heritage tourism basically refers to the activity of focusing travel on places where you can experience the people and events of the past. According to Community Heritage Group, national studies indicate that 40 percent of all people visit historic sites when they travel. Demographic data indicate that the aging population is contributing to this trend. Over the last decade, most countries and many states in this

country have developed programs to attract heritage tourism into their area. For example, within the current plan area, the Mariposa County Plan recognizes the need to identify historic districts, and develop them for tourism. The benefits of heritage tourism on local economies, especially economically depressed rural communities, can be significant, since it is reported that the heritage tourist stays longer, spends more, and is more respectful of the local community. Current management direction does not address the need to engage in public archaeology or assist the local tribal and governmental partners with heritage tourism. If management direction does not change, for the next 10-20 years the increasing public demand for these experiences will not be met. Additionally, the ability to assist our local partners with the economic revitalization of rural American communities in the plan area will be diminished.

Illegal Activities

Looting and vandalism is on the rise. Sometimes people are unaware that removing historic and prehistoric artifacts from the forest is a crime. On the other hand, there are people who know it is illegal, and intend to steal government property to sell it. While some looting occurs by uninformed and curious members of the public, others are actively conducting excavations on prehistoric sites, and even dismantling historic mines and mills to sell for scrap. The impacts to cultural resources are cumulative and irreparable. You cannot create an 8,000 year old village. Once it is gone, it is gone forever. As the population increases, the number of looting and vandalism incidents has risen. Currently, the Sierra NF is stretched to respond appropriately to the reports of looting incidents. The projected budget shortfalls and decreased staffing expected over the next 10-20 years will likely exacerbate the problem. Under current management direction, the Sierra NF is expected to have difficulty meeting its legal mandate to protect these resources from criminal activity.

Marijuana cultivation on National Forest System (NFS) lands is increasing. Law enforcement activities tend to concentrate on a few forests at a time, which can successfully limit the activity on targeted forests temporarily. As law enforcement shifts attention to other forests, the growers return to their old plantations. Impacts to cultural resources can result from: ground disturbing activities that directly affect resources, impacts to plant and animal species that are important cultural resources for Native Californians, and hazardous conditions to access gathering areas and ceremonial places due to safety and health issues. There is little data regarding effects from unauthorized marijuana cultivation on cultural resources. Under current management direction, impacts to cultural resources are not being inventoried, analyzed, and reported. Activities related to this issue are conducted in secret both by the growers and the law enforcement officers who combat them. The eradication of illegal plantations and their clean up and restoration are exempt undertakings under the Pacific Southwest Region of the Forest Service's Programmatic Agreement, and are not subject to review. If this management direction continues, irreparable damage may occur with no documentation or mitigation actions in place.

Native Californian Traditional Use

For decades, the Sierra NF has had an exemplary relationship with local Native Californian tribal governments and community, holding regularly scheduled information sharing and consultation meetings, as well as having an "open door" policy to them for issues and concerns. Tribal people actively gather traditional resources, conduct religious ceremonies, and consult with the Sierra NF over planned activities and projects. The relationship between the California Native American tribes and the Sierra NF is based

in constitutional law, and is part of the trust responsibility of the forest. Therefore, management direction is determined more by the promulgation of new regulation and policy than it is by a new land management plan. Looking forward to the next 10-20 years, the Sierra NF will redeem its trust responsibility to the California Native American tribes. In the future, the changing political and social landscape may conflict with other uses, and have consequences for forest management. Namely, the increasing population in general will be place more demand on forest resources, including recreation, forest products, facilities and infrastructure. For example, plant species that are critical components of Native Californian culture are also highly prized by other members of the public, and traditional religious practices require solitude and secrecy, increasingly hard items to provide on a forest where the size and scope of activities is increasing, but the land base is not. Based on local, regional, and national interest in traditional aboriginal land use by Native Americans, it is projected that Native Californian traditional use of Sierra NF lands will intensify over the next decade or two. Land management planning should take into account the possibility of increased conflicts between Native California traditional uses and the Forest Service land management policy of multiple uses.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Cultural uses or cultural and historic resources contribute to sustainability through archaeological deposits that serve as archives of scientific data, documenting past climatic conditions. In addition, these deposits serve as the only source of scientific data documenting past human adaptations to climate change. This information, along with historical records and traditional ecological knowledge provide a baseline of information valuable for ecological restoration and sustainability projects. Cultural resources expand our knowledge and understanding of history and culture, and help us connect to our heritage. The heritage resources program on the Sierra NF can play a critical role in enhancing socioeconomics of local communities by offering opportunities for employment and income from heritage tourism and recreation. The benefits of heritage tourism on local economies, especially economically depressed rural communities can be significant. Heritage tourists stay longer, spend more, and are more respectful of the local community. Additionally, cultural resources are a primary component of the Sierra NF's mandated trust responsibility to Indian tribes. Tribal communities benefit socioeconomically through the use of cultural resources for artisan and craft material, medicinal purposes, fuel, and traditional foods, and by supporting heritage tourism and recreation. Cultural resources on the Sierra NF also enhance the sustainability of tribal communities by providing opportunities for traditional ceremonies and religious practices that strengthen the community's sense of place and self. Gathering activities on the forest play an important role in contributing to social, economic, familial, and religious benefits.

Information Gaps

The current expanded definition of cultural resources includes categories of resources extremely important to the sustainability of tribal culture but that were traditionally viewed as "natural," so additional categories of sites, districts, and cultural landscapes likely exist but have yet to be identified and evaluated. In addition, the relatively new understanding about Native Californian resources and their contributions to the historic period will likely change how that context is understood and described in the future with further research and tribal consultation. Understanding of significant tribal events, individuals, and themes during this period is not well understood. Little information on mining on the Sierra NF is available, because the history of mining has never been synthesized. There is also little data about the effects of unauthorized marijuana cultivation on cultural resources because these activities are often dealt

with covertly. Finally, many areas of the Sierra NF have not been inventoried for cultural resources, so the number of cultural resources may be underestimated. For those resources that have been identified, limited information is available regarding their condition because the majority of these have not yet been evaluated.

Chapter 14: Lands

Important Information Evaluated in this Phase

Lands Ownership

The definition of Landownership Status is ownership records of title to lands, including withdrawals, rights, or privileges affecting or influencing the use and management of National Forest System (NFS) lands. It is the system of assembling, recording, and making landownership and related information available to field personnel.

Land Status

Land status for public lands refers to the use of specific designations of a geographic area that provides general guidance and policy for the management of a defined geographic area.

Lands Uses

Land Uses are covered by Special Use Authorizations which include permits, leases and easements that allow occupancy, use, rights, or privileges of NFS lands. Special use authorizations are legal instruments whose terms and conditions are fully enforceable when reasonable and consistent with law, regulations, and policy. The mission of the Special Use Program is to manage the use and occupancy of NFS land in a manner that protects natural resource values, promotes public health and safety and is consistent with forest land and resource management plans.

Access and Access Patterns

The Sierra NF Transportation System (NFTS) was developed over many decades to meet a variety of needs.

Nature, Extent and Role of Existing Conditions and Future Trends

Lands Ownership

As established in 36 CFR 200.12, the LSRS is the official repository for all realty records and land title documents for NFS lands. LSRS records include an accurate account of acreage, condition of title,

administrative jurisdiction, rights held by the United States, administrative and legal use restrictions, encumbrances, and access rights on land or interests in land in the NFS.

Maintenance of the Land Status Records System includes the final review, processing, posting, and permanent retention of records creating any change in landownership status. This includes notation and filing of laws and Executive Orders affecting landownership and jurisdiction, all landownership adjustments (exchange, purchase, donation, transfer, boundary modification, title claims, sales, grants, excess property), use restrictions (withdrawals, designations, dedications, wilderness, other special areas), encumbrances (rights-of-way acquired or granted, reservations, outstanding rights, partial interests, easements), and changes attributable to resurveys.

The Land Areas of the National Forest System Report (LAR) is an annual publication that tracks NFS ownership and provides the latest statistics on land areas administered by the Forest Service. The report provides acreage figures for NFS lands in a variety of ways such as by forest, by state, for wilderness areas and other special designations.

The Forest Service "Forests on the Edge" project uses GIS to identify areas across the country where private forest services such as timber, wildlife habitat and water quality might be affected by factors such as development, fire, insects, and diseases. Specifically the report issued August 2007 titled "National Forests on the Edge – Development Pressures on America's National Forests and Grasslands" seeks to understand where increases in housing density on lands adjacent to NFS lands might affect recreation wildlife, water resources, and other important public benefits.

The Sierra NF's administrative boundary encloses 1,395,554 acres of which 109,493 are non-federal. The pattern of private holding is generally irregular and scattered along the forest's western boundary at the lower and mid elevations.

Land Status and Uses

Land use for private land located on the Sierra NF is under the control of the local county. The county defines the appropriate type and intensity of use in its County General Plan and administers this direction through zoning ordinances.

Public land on the Sierra NF may be classified and identified by special status that provides strategic management direction. Some of the types of land designations and their acreages have significant effect on the allowable land uses.

Most externally-imposed needs will be associated with accelerated hydroelectric generation developments, and community expansion. As more private land within the forest is developed, more demand will be placed on public land for community uses. Recent requests for community water systems and sewer plant effluent spray fields of forestland are examples of this trend. Permits related to urban uses will not normally be provided in areas where county zoning calls for limited urban development.

Classifications for public lands with special status on the Sierra NF

Special status classification	Acreage
Administrative sites	556
Developed recreation	75,965
Experimental forest	3,200
Experimental range	4,580
Kings river special management area	24,368
Research natural areas	4,130
Special interest areas (botanical/geological)	5,093
Wild and Scenic River	27,040
Wilderness	527,938

Access and Access Patterns

For information about the Sierra NF's road and trail systems that provide access throughout the forest see the transportation section under Chapter 11 of this assessment.

Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability

Access is vital for timber management, fuel treatment, private in-holdings, fire control, utility management, special uses and recreation and harvesting of special forest products. Access is provided on the Sierra NF by the NFTS. For the contribution of the NFTS to the plan area, please see the Chapter 11 section Contributions the Plan Area Makes to Ecological, Social or Economic Sustainability.

Understanding people's relationships to public lands plays a vital role in travel management planning. Despite apparent differences in opinion, the public, through comments, has revealed a strong connection with public lands on the Sierra NF. Connections are based on generations of use and exploration, as well as traditions that are still in the making.

Information Gaps

The Sierra NF recognizes the need to assess the unauthorized routes that were not brought into the system and are potential future consideration for removal and restoration, or addition to the NFTS. Future decisions associated with changes to the NFTS are dependent on available staff and resources and may require additional environmental analysis, public involvement and documentation.

The Sierra NF acknowledges the public request to retain the access and availability of historic parking and staging opportunities along road spurs in light of the prohibition on cross-country travel and the limitation of parking one vehicle length from the NFTS road. Public input helped clarify the need for addition of some of these routes in to provide access to important recreation opportunities and experiences, access to private inholdings, administrative sites, and access to projects such as biomass, fuels reduction or ecosystem restoration.

Chapter 15: Designated Areas

Important Information Evaluated in this Phase

Designated areas direct specific kinds of management on land within the Sierra NF plan area. The purposes and types of established designated areas are described in this chapter. Location information for Sierra NF designated areas can be found in the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15.

The current and potentially designated areas on the Sierra NF are listed below.

Statutorily Designated Areas on the Sierra NF:

- National Scenic Trails
  - Pacific Crest National Scenic Trail
- Wild and Scenic Rivers
  - Merced River
  - South Fork Merced River
  - Middle Fork Kings River
    - Kings River Special Management Area
- Wilderness, or Wilderness Study Areas
  - Kaiser Wilderness
  - Dinkey Lakes Wilderness
  - Ansel Adams Wilderness
  - John Muir Wilderness
  - Monarch Wilderness

Administratively Designated Areas on the Sierra NF:

- Experimental Forest or Range
  - San Joaquin Experimental Range
    - Teakettle Creek Experimental Forest
- Inventoried Roadless Areas
- Research Natural Areas (RNAs)
  - Backbone Creek Research Natural Area
  - Sacate Ridge Research Natural Area
  - Blue Oak – Foothill Pine RNA (within the San Joaquin Experimental Range)

- Scenic Byway
  - Sierra Heritage Scenic Byway
  - Sierra Vista Scenic Byway
- National Recreation Trails
  - Black Point Trail
  - Rancheria Falls National Recreation Trail
  - Kings River National Recreation Trail
  - Lewis Creek National Recreation Trail
  - Shadow of the Giants National Recreation Trail

Regional Forester Designated Areas:

- Botanical Area
  - Carpenteria Botanical Area
  - Devil's Peak Botanical Area
  - McKinley Grove Botanical Area
- Geological Area
  - King Caverns Geological Area
  - Courtright Intrusive Contact Zone
  - Dinkey Creek Roof Pendant
  - Crater Lake Meadow Geological Area
- Historical Area
  - Nelder Grove Historical Area

Potential Designated Areas that May be Considered:

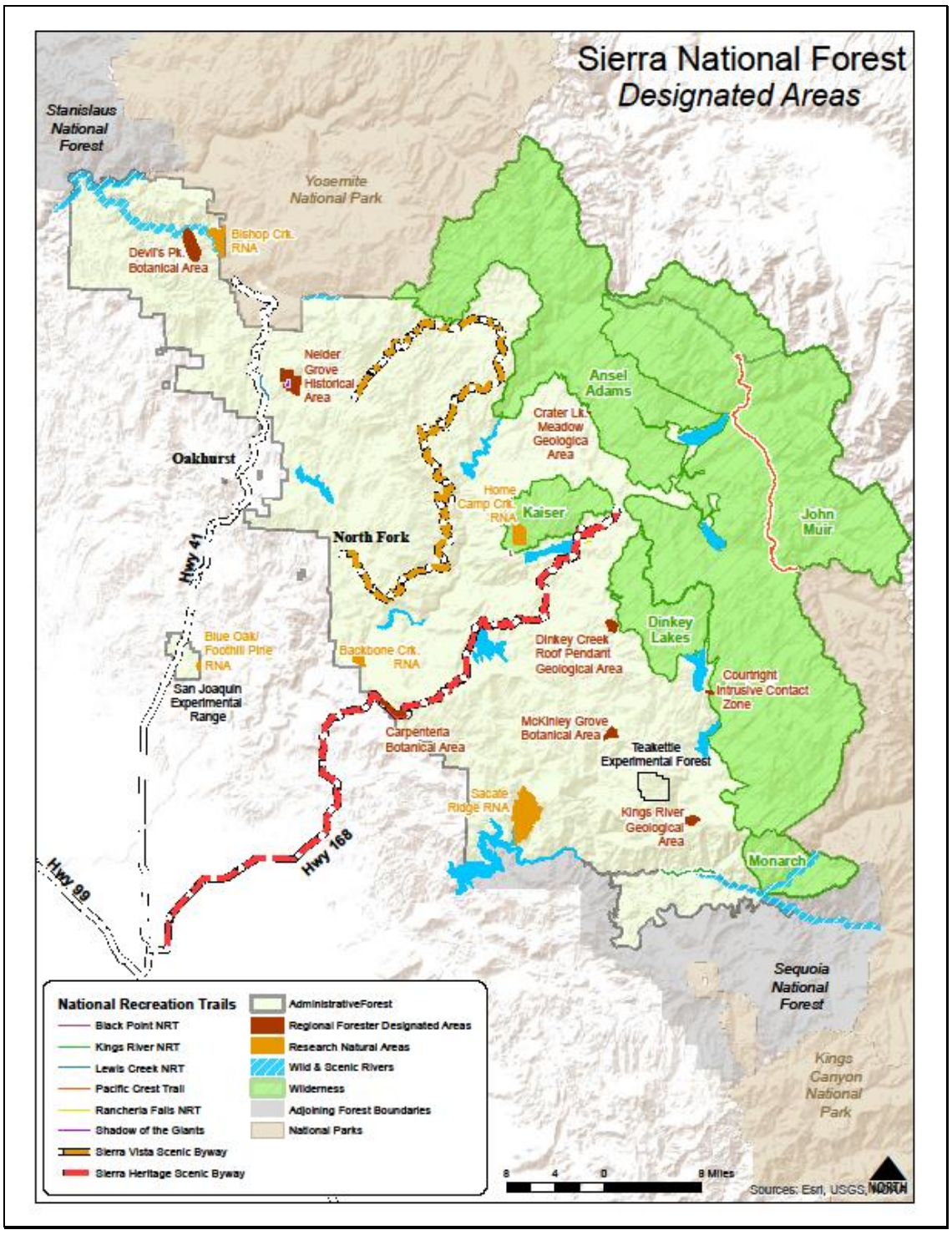
- Inventoried Potential Wild and Scenic Rivers
  - San Joaquin River
  - South Fork San Joaquin River
- Stakeholder Requested Wild and Scenic River Designation
  - Dinkey Creek
- Potential Research Natural Areas (RNAs)
  - Proposed Bishop Creek Ponderosa Pine RNA
  - Proposed Home Camp Creek White Fir/Red Fir RNA

Proposed Heitz Meadow Mixed Conifer RNA

- Significant Caves

  Potential Kaiser Wilderness Geological Area

The map below shows the location of the designated areas throughout the forest. Wilderness tends to be along the eastern boundary of the forest connecting the Sequoia NF to Yosemite National Park and the bordering Kings Canyon National Park. Wild and scenic rivers flow from the slopes of the Sierra Nevada Mountains on the eastern edge of the forest toward the west and the valley. These rivers are both on the northern and southern ends of the forest with the potential wild and scenic rivers in canyons between these designated rivers. Scenic byways are located toward the middle of the forest with one traversing from Highway 41 up through the middle of the forest while the other curves from North Forth toward the wilderness and back. RNAs and special interest areas are scattered throughout the forest depending on the topography or ecology that makes them special. The Pacific Crest National Scenic Trail traverses the crest of the Sierras in wilderness, while the national recreation trails follow river courses or other scenic areas.



Designated areas on the Sierra NF

Nature, Extent and Role of Existing Conditions and Future Trends

Pacific Crest National Scenic Trail

The Pacific Crest National Scenic Trail (PCT) was established to provide high quality scenic, primitive hiking and horseback riding opportunities and to conserve natural, historic, and cultural resources along the corridor. The PCT travels through the Sierra NF for 27 miles, with a mile wide trail corridor, all in designated wilderness.

In the last ten years, wildland fire has played a significant role in the accessibility and scenic experience of the PCT for hikers and equestrians on the Sierra NF. Over ten percent of the trail has burned, but none of that was considered "high intensity" fire. The scenic attractiveness of a landscape can be altered from natural events such as floods and fire. However a guiding principle of wilderness management is that natural ecosystem processes are allowed to proceed naturally with as little interference by humans as possible (Ketscher 2013).

The PCT and John Muir Trail are coincidental throughout the Sierra NF. The popularity of long distance trails in general, and the John Muir Trail specifically, is growing, and there has been an increase in the numbers of visitors for through-hike use on the PCT. This trend is expected to continue. There are no known capacity issues on the PCT on the Sierra NF at this time.

Current trends in ecological conditions are expected to continue, including elevated fuel loads with risk of high severity wildfire, loss of meadows with conifer encroachment, and other ecosystem disturbance associated with climate change, such as extreme wind events. Significant changes in the past 10-50 years relate to heavy precipitation followed by a significant wind event. Though the PCT itself was not overly impacted in 2012, a majority of the trails that access the PCT on the Sierra NF were impacted when a wind event felled up to 100 trees per mile on these trails. The resulting issue will be the fuel loading from all the downed trees below the trail. A strategy to resolve the fuel loading in the wilderness is in early discussions. More information about these ecological trends can be found in Chapters 1, 2 and 3 of this assessment. For more detailed information on the PCT see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 103-160.

Wild and Scenic Rivers

Congress passed the National Wild and Scenic Rivers System Act in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) for the purpose of preserving rivers with outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values in a free-flowing condition for the enjoyment of present and future generations. Each river in the National Wild and Scenic River System (NWSRS) is administered with the goal of protecting and enhancing water quality, free-flow, and the outstandingly remarkable values (ORVs) for which it was designated.

As per the current LRMP (USDA Forest Service 1991b) river segments totaling 82.5 miles are managed as part of the NWSRS. Nearly 26,400 acres are included in these river corridor management classifications. For more detailed information on wild and scenic rivers, see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 243-273, as well as the Sierra Nevada Bio-Regional Assessment.

Merced Wild and Scenic River

In November 1987, the main stem and south forks of the Merced River were designated as the Merced Wild and Scenic River. In addition to portions managed by the Sierra NF, portions of this designation are also within Yosemite National Park and on lands managed by the Bureau of Land Management. For more detailed information describing the Merced River Wild and Scenic River segments see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 276-510.

The identified ORVs of the South Fork of the Merced River segments on the Sierra NF are:

- Recreation (fishing, nature study, white water rafting)
- Geology (oldest gold-bearing rocks)
- Wildlife (important riparian-dependent wildlife: limestone salamander (state-listed rare species)
- Fisheries (rare, lower elevation, high value, suitable riparian habitat for native fish)
- Botany (Segment 6 only - four state-listed rare/endangered plants)
- Cultural and Historic Landscape

The identified ORVs of main stem Merced River segments on the Sierra NF are:

- Geology (the contact between meta-sedimentary and granitic rock)
- Vegetation (4state-lkted rare and endangered plants within the vegetation/botanic zone)
- Wildlife (threatened limestone~ salamander habits)
- Recreation (white water rafting, camping and hiking)
- Cultural/historical benefits (old Yosemite railroad and old mining sites)

As visitation to Yosemite National Park increases, there is expected to be spill over into the Merced River canyon with visitor demands for recreational opportunities such as camping, hiking and site seeing. See Chapter 3 and Chapter 6 of this assessment for more detail on expected increased populations in the plan area. Currently the recreation in this corridor is at maximum capacity but stable. The whitewater rafting on the Merced River is limited by permit at or below the maximum allowable under the wild and scenic river management plan. Due to the canyon's width prescribed by the geologic features and the management requirements, there are limits to acceptable expansion. It is anticipated that there will be a public demand for additional bicycle and hiking trail opportunities. It is also anticipated that there will be additional demands for camping opportunities including both dispersed camping and managed camping. Additional recreational opportunities are possible as long as they are compatible with the wild and scenic river segment classification (wild, recreational, or scenic), ORVs, and other river values. However, budgets and priority trends show that resources would likely be focused on effectively managing existing facilities and decommissioning facilities that are underutilized, rather than adding additional facilities. There is a trend toward unmet public recreational demand in the corridor of the Merced WSR (Martin 2013).

The Merced River canyon including the wild and scenic river corridor is a large and unique area particularly for its unique chaparral type. This ecosystem spans from the canyon bottom to Yosemite National Park. Currently the ecosystem is not in a sustainable condition as it needs burn disturbance that is part of the pattern under which the ecosystem evolved (Martin 2013).

Fires under current conditions are likely to be too big and too hot to recreate a classic chaparral mosaic. Drivers of system change, such as flat budgets, decreasing staffing and air quality regulations that limit burning result in an unsustainable less resilient ecosystem and preclude getting to a more sustainable fire regime (Martin 2013).

Due to increasing precious metal values, there are increasing claims on stream courses on the Sierra NF. There is a trend toward precious metal mining which may impact the Merced River and its corridor. The likelihood of this is currently undetermined however this possibility exists (Martin 2013). No new mining claims or mineral leases can be granted for river segments classified as wild.

Kings Wild and Scenic River

In November 1987 the Kings River was designated as wild and scenic, including the entire Middle and South Forks. Six miles of the Middle Fork portion of the designation are on the Sierra NF. Sequoia and Kings Canyon National Parks also manage portions of the Kings Wild and Scenic River. For more detailed information on Middle Fork Kings River segments see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 512-593.

The identified ORVs of the Middle Fork of the Kings River segments on the Sierra NF are:

- Geology (glaciers, volcanic remnants, premier granitic dome exfoliation (segment 1) classic V-shaped canyon (segment 2)
- Vegetation (three rare plants - segment 1)
- Wildlife (resident golden eagle, bald eagles winter here (segment 1), potential site for peregrine falcon, stable wildlife population (segment 2)
- Recreation (John Muir Trail, classic mountain climbing (segment 1) rugged and without trail access (segment 2), white water rafting)
- Scenery (premier scenic rivers, spectacular vistas, 3,600 foot rise to domes, glacial valley (segment 1) very rugged, distinctive, deep valleys (segment 2)
- Culture and History (John Muir Trail, trans-Sierra Indian trail, major Indian rock paintings –segment 1)

Trends Affecting Wild and Scenic Rivers

There is gang activity in this area. Law enforcement is stretched thin and in remote areas there is a higher likelihood of unauthorized or illegal activity. In some cases, this includes marijuana gardens.

There are also places in this area where there is high use by the public which leads to trash and sanitation issues. Diverse cultures are using the land. In some locations, there is dumping of refuse such as furniture.

There is a trend toward greater use of the forest overall as the population in the central valley and California increases. See Chapter 6 of this assessment for more information on demographics. There is also a trend toward different kinds of use of the forest as the number of visitors with different values for public lands increase. There is a trend toward larger groups of dispersed campers, less knowledge of hunting and fishing regulations, less knowledge of techniques for using the land lightly or leave no trace. These changing human dynamics influence the resources near areas where people congregate or use the land. These heavier human pressures may lead to less sustainability in areas where dispersed camping is popular.

There is an accumulation of fuel load in this area since the era of fire suppression which could trend to uncharacteristic wildfire. As the river is used for white water rafting and attracts other recreationists, there are more people focused on this area and more possible sources of ignition.

Due to the increased density of the forest, there are dying trees in this area which can lead to insect and disease outbreaks. There have been some hazard tree reductions in this area, however only enough to minimally reduce the trend toward overly dense forests.

Eligible Rivers

Before the Sierra NF Forest Supervisor invites comments on the proposed plan, an inventory of rivers and a review of their eligibility for inclusion in the NWSRS is required (USDA Forest Service 2012b). This inventory is not required during the assessment. It has not yet been determined if a suitability analysis of eligible rivers will be completed as part of the forest plan revision. If suitability analysis is completed, those rivers on the inventory found to be eligible will be evaluated and a decision will be made whether or not to recommend them for designation as wild and scenic rivers.

In previous efforts to inventory and evaluate rivers for eligibility, the San Joaquin River was inventoried. The following portions of the river were free flowing and possessed outstandingly remarkable scenic values, making them eligible for recommendation for WSR designation.

San Joaquin River

The San Joaquin River is an inventoried river that has been found to be eligible and includes 14 miles from Mammoth Pool Reservoir to the confluence of Middle and North Forks San Joaquin River. River segments 1 and 2 are on the Sierra NF. For more detailed information on eligible San Joaquin WSR segments see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 605- 647.

The identified outstandingly remarkable values of San Joaquin River segments on the Sierra NF are:

- Geology – several waterfalls, V-shaped, 2000 foot gorges (both segments 1 and 2)
- Fisheries – excellent native self-sustaining rainbow trout (both segments 1 and 2)
- Scenery – spectacular granite walls and domes, waterfalls (both segments 1 and 2)

North Fork San Joaquin River

Fourteen miles of the North Fork San Joaquin River have been inventoried and found to be eligible. River segments 1, 2 and 3 are on the Sierra NF. For more detailed information on eligible North Fork San Joaquin WSR segments see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 650-689.

The identified outstandingly remarkable values of the North Fork San Joaquin River segments on the Sierra NF are:

- Geology – outstanding meta-volcanic rock, glaciated valley, deep, narrow canyons (segments 1, 2 and 3)
- Wildlife– potential for peregrine falcon, deer summer range (both segments 2 and 3)
- Recreation – outstanding hiking, fishing, camping, rare elevation change (both segments 1 and 2)
- Scenery – excellent views of Ansel Adams peaks and snow fields (segments 1, 2 and 3)

- Culture and history – French (Indian and mining) Trail at Sheep Crossing (segment 3)

Middle Fork San Joaquin River

Nine miles of the Middle Fork San Joaquin River have been inventoried and found to be eligible. Part of river segment 1 is on the Sierra NF. For more detailed information on eligible Middle Fork San Joaquin WSR segments see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 692-764.

The identified outstandingly remarkable values of the Middle Fork San Joaquin River segments on the Sierra NF are:

- Geology – glaciated granite gorge with domes, volcanic activity evident
- Fisheries – golden trout in upper reaches
- Recreation – fishing prime use; rock climbing, unusual free-flowing mountain river
- Scenery – spectacular domes and deep granitic canyons

South Fork San Joaquin River

The South Fork San Joaquin River has been inventoried and found to be eligible. Three miles of the river are on the Sierra NF. For more detailed information on eligible South Fork San Joaquin wild and scenic river segments see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 766-809.

The identified outstandingly remarkable values of the South Fork San Joaquin River segments on the Sierra NF are:

- Geology – classic glaciated valleys, peaks (segment 1); granite gorge with domes
- Wildlife – potential peregrine falcon site
- Scenery –mountain vistas, whitewater

Dinkey Creek

In 1990, Friends of the River and the Dinkey Alliance submitted their citizen's assessment of Dinkey Creek's potential wild and scenic values to the Forest Service. The assessment determined that 27 miles of the creek, from its source at Dinkey Lakes to its confluence with the North Fork Kings River, were free flowing and possessed outstandingly remarkable scenic values.

In 2003, 2006, and 2007, Senator Barbara Boxer introduced the California Wild Heritage Act. All three versions of the bill proposed adding Dinkey Creek to the NWSRS. None of the bills were ratified. The forest continues to manage Dinkey Creek to protect the values identified.

Wilderness

Designated wilderness comprises 44 percent of the total 1,322,913 acres that make up the Sierra NF. There are five designated wilderness areas, either in whole or part, within the administrative boundary of the Sierra NF. The geographic area for these wildernesses ranges from 21,000 to 351,957 acres. Before the Sierra NF Forest Supervisor invites comments on the proposed plan, an inventory and evaluation is

required for wilderness (USDA Forest Service 2012a). This inventory and evaluation is not required during the assessment.

Wilderness acres and permits on the Sierra NF

Wilderness	Total Acres	Acres in Sierra NF	# of wilderness permits issued in 2012
Ansel Adams	231,279	151,483	1,020
Dinkey Lakes	30,000	30,000	640
John Muir	581,000	351,957*	1,672
Kaiser Wilderness	22,700	22,700	Not available
Monarch	44,896	21,000	1,672
Total	909,875	577,140	

*Approximately 26,000 acres in the northern portion of the Fish Creek watershed are Sierra NF lands administered by the Inyo NF.

Acreage of wilderness may be based on differing criteria and therefore may differ somewhat throughout the document. For example, in some acreage totals, private land may be included.

Sierra NF wilderness management is designed to maintain and protect wilderness character and wilderness values. In general, conditions affecting wilderness areas on the Sierra NF include:

- *Fire suppression*. Fire management activities, in this case active suppression actions, can be viewed as a driver of the untrammeled quality of the wilderness character on the Sierra NF. Although the Sierra NF has in recent years managed some lightning fires across the wilderness landscape, active suppression occurs on nearly 100 percent of these fires for a number of reasons, including air quality constraints, resource commitments, and risk-based decision making. As we better understand fire's role in these ecosystems and as decision-makers are given better tools to reduce risk, it is anticipated that the Sierra NF will begin to manage more naturally-caused fires in wilderness.
- *Fish stocking*. While there has been a regional trend toward less fish stocking, stocking continues in wilderness lakes. The continued presence of non-native fish, especially in historically fishless lakes, degrades the untrammeled and natural qualities of wilderness character.
- *Black bear food conditioning*. Food conditioning of black bears in Sierra NF wildernesses continues to be a problem in limited areas.
- *Cattle grazing*. Special provisions in legislation allow cattle grazing to be permitted on several allotments in Sierra NF wildernesses. Stocking levels have been reduced in some allotments and several wilderness allotments are vacant. Overall, there has been slightly less grazing in wilderness and closer management of cattle movement between allotment subunits.
- *Air quality*. Monitoring is done on visibility and atmospheric deposition of pollutants in alpine lakes. The Ansel Adams, John Muir, and Kaiser Wildernesses are Class I areas on the Sierra NF, meaning they are sensitive air quality areas that require extra protection. See Chapter 2 of this assessment for more information.
- *Public Demand.* People are drawn to water. Wilderness areas that include meadows, streams and lakes receive the most intensive use. There is also a trend toward more day trips in wilderness and fewer

multi-day trips. There is more intense use of wilderness closer to trailheads and population centers to support the demand for one day wilderness hiking opportunities. For more information see Chapter 9 of this assessment.

- *Enforcement.* Wilderness enforcement issues intensify at abrupt transitions between motorized use and wilderness. Enforcement issues have been more likely to occur at the interface of the Kaiser Wilderness as it is very close to the populated Huntington Lake area.

Conditions and trends that affect wilderness character vary across the different wildernesses and are further discussed below. A closer examination of the threats associated with each wilderness are currently being identified and prioritized for a multi-year data gathering and restoration process.

Kaiser Wilderness

There is no separate management plan for the Kaiser Wilderness. Area management is guided by the 1992 LRMP. Wilderness direction for the Ansel Adams, John Muir and Dinkey Lakes Wildernesses has been substantially updated and amended by the 2001 Wilderness Plan, which was further amended by the 2005 Commercial Pack Stock EIS. The Kaiser Wilderness was not included in any of these planning actions. Early in the wilderness planning process, which began in 1991, it was recognized that the Kaiser Wilderness was sufficiently different from the other wilderness areas on the forest to warrant a separate management plan. The Kaiser Wilderness is relatively small, geographically separated, has different use patterns, such as more day use and less overnight use, and is adjacent to the near-urban environment of Huntington Lake. All of these factors contributed to the decision to prepare a separate plan, however a Kaiser Wilderness Management Plan has not been initiated at this time. Management direction contained in the 1992 LRMP is still valid.

The Kaiser Wilderness currently meets the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge. The full performance level is being met for air quality monitoring, recreation site condition inventory, and outfitter/guide administration. The minimum stewardship level has been reached for fire planning, wilderness education, collection of baseline information, and workforce. The wilderness does not meet the minimum threshold for non-native invasive plant control, preservation of outstanding opportunities for solitude, and adequate planning direction to prevent degradation of the wilderness resource.

Wilderness character in the Kaiser Wilderness is moderately affected by cattle grazing, fish stocking, fire suppression, and recreational activity. In addition, modern development outside of the wilderness affects air quality, the natural soundscape, and dark night skies. Generally, the undeveloped quality of wilderness character and opportunities for solitude or primitive and unconfined recreation is preserved.

For more detailed information on the Kaiser Wilderness see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 884-986.

Dinkey Lakes Wilderness

In addition to the applicable desired future conditions in the 1992 LRMP, the 2001 Wilderness Plan outlines an additional set of desired future conditions for the Dinkey Lakes Wilderness.

The Dinkey Lakes Wilderness does not currently meet the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge. The full performance level is being met for recreation site

condition inventory. The minimum stewardship level has been reached for fire planning, wilderness education, field data collection, storage and analysis and preservation of outstanding opportunities for solitude, outfitter/guide administration, and forest plan direction to prevent degradation. The wilderness does not meet the minimum threshold for non-native invasive plant control, collection of baseline information air quality monitoring, and having a baseline workforce. The wilderness management stewardship level trend from 2005 through 2009 is stable.

Wilderness character is moderately affected by fire suppression and recreational activity. Generally, the undeveloped quality of wilderness character and opportunities for solitude or primitive and unconfined recreation is preserved.

For more detailed information on the Dinkey Lakes Wilderness see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 990-1170.

Ansel Adams Wilderness

In addition to the applicable desired future conditions in the 1992 LRMP, the 2001 Wilderness Plan outlines an additional set of desired future conditions for the Ansel Adams Wilderness.

The Ansel Adams Wilderness does not currently meet the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge. The full performance level is being met for recreation site condition inventory. The minimum stewardship level has been reached for fire planning, wilderness education, preservation of outstanding opportunities for solitude, outfitter/guide administration, adequate planning direction to prevent degradation of the wilderness resource, and collection of baseline information. The wilderness does not meet the minimum threshold for air quality monitoring, non-native invasive plant control and establishment of a baseline workforce.

Wilderness character is moderately affected by fire suppression and recreational activity. Generally, the undeveloped quality of wilderness character and opportunities for solitude or primitive and unconfined recreation is preserved.

For more detailed information on the Ansel Adams Wilderness see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1174-1338.

John Muir Wilderness

In addition to the applicable desired future conditions in the 1992 Sierra NF LRMP, the 2001 Wilderness Plan outlines an additional set of desired future conditions for the John Muir Wilderness.

The John Muir Wilderness does not currently meet the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge. The full performance level is being met for recreation site condition inventory. The minimum stewardship level has been reached for fire planning, wilderness education, preservation of outstanding opportunities for solitude, outfitter/guide administration, collection of field data, storage and analysis, and adequate planning direction to prevent degradation of the wilderness resource. The wilderness does not meet the minimum threshold for non-native invasive plant control, air quality monitoring, and workforce.

For more detailed information on the John Muir Wilderness see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1342-1360.

Monarch Wilderness

Management challenges include risks associated with wildfire aggravated by extremely steep slopes and protecting the wilderness character.

The Monarch Wilderness does not currently meet the minimum stewardship standard defined in the 10-Year Wilderness Stewardship Challenge. The full performance level is being met for air quality monitoring. The minimum stewardship level has been reached for fire planning, wilderness education, and recreation site condition inventory. The wilderness does not meet the minimum threshold for non-native invasive plant control, preservation of outstanding opportunities for solitude, adequate planning direction to prevent degradation of the wilderness resource and information management and base line workforce.

For more detailed information on the Monarch Wilderness see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1364-1467.

Inventoried Roadless Areas

The Sierra NF has 146,569 acres of inventoried roadless areas outside of wilderness.

Inventoried roadless areas are managed for preservation. No additional roads are added. These areas are sustainable from the standpoint of their "roadlessness". However, the ecological sustainability of these areas is influenced by the ecological health of the forest which is addressed in Chapter 1 of this assessment (Burkindine 2013a).

Overall forest health is threatened by the densification of the forest leading to disease and insect infestation, the lack of fire operating in the ecosystem, the fuel load accumulation due to fire suppression and changed hydrologic conditions in riparian areas and meadows.

Currently identified roadless areas tend to be in drier lower elevation areas with few water features. Forest staff has observed less recreation use of these areas (Barnett 2013).

For more detailed information on inventoried roadless areas see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1493-1514.

Research Natural Areas

Research Natural Areas (RNAs) are National Forest System (NFS) and other public lands permanently protected to maintain biological diversity and provide ecological baseline data, education and research. Only non-manipulative research is allowed within the RNAs. RNAs have been selected based on vegetation target elements. Three RNAs have been established on the Sierra NF and three others are candidates for establishment (Cheng ed. 2004).

The 430 acre Backbone Creek RNA is located about 1.5 miles north of the town of Auberry and was established in 1971. It was established because it is an excellent representative of the unique mixed chaparral of eastern Fresno County, highlighting the rare shrub tree-anemone. Recreational use is discouraged in order to protect the natural ecosystem for research and study. Livestock grazing is prohibited. Encumbrances of land are prohibited except those needed for research. Roads, trails or

trailheads will not be constructed and sensitive plants are protected. There are limits on the type of fuel suppression equipment that can be employed and the amount of fuel treatment that can occur.

The 3,995 acre Sacate Ridge RNA was established in 2006 to represent the blue oak-foothill pine vegetation type (Eyre 1980) in the Sierra Nevada foothills, along with several other vegetation types that were not yet represented in the RNA system. Although livestock grazing is usually not permitted within RNAs, in this case the RNA has active cattle grazing allotments, and grazing will continue. The opportunity to study different grazing practices on the vegetation within the RNA is a goal of establishment.

The 80 acre Blue Oak–Foothill Pine RNA, within the San Joaquin Experimental Range, supports a mixture of foothill blue oak and digger pine and associated annual grass and clover species. The experimental range and RNA were established over 70 years ago to protect the site for research and ecological study of the blue oak–digger pine ecosystem. The San Joaquin Experimental Range is not managed by the Sierra NF and is therefore not part of the plan area.

Livestock use, mining, and encumbrances are prohibited. No new roads, trails or campgrounds will be constructed. The area is not suited to timber harvest. Wildfires are extinguished as quickly as possible to protect the research values and the forage resource.

The 1,140 acre Bishop Creek Ponderosa Pine RNA is proposed to protect the Pacific ponderosa pine for research and ecological study. If established, livestock use, mining, encumbrances and timber harvest would be prohibited, and no new roads or trails would be constructed. Wildfires would be extinguished as quickly as possible to protect the research values, although a formal management plan for the RNA might allow some wildland fire use as in wilderness (FSM 4063.02). The Bishop Creek Ponderosa Pine RNA is at high risk for being impacted by uncharacteristic wildfire. Uncharacteristic fire may impact Ponderosa pine sufficiently and of a magnitude that the research purpose could be lost.

The proposed 1,200 acre Home Camp Creek White Fir-Red Fir RNA is a candidate. If established it would be dedicated to research and study of the white fir-red fir ecosystem. If established, livestock grazing would be permitted, however timber harvesting, mining and encumbrances would be prohibited. No new roads or trails would be constructed.

The proposed 1,200 acre Heitz Meadow Mixed Conifer RNA was a candidate to represent the Sierra Nevada Mixed Conifer Element. Five conifers and one hardwood define the type: sugar pine, ponderosa pine, Jeffrey pine, incense cedar, white fir and black oak. An environmental assessment was written in 2006 to establish several RNAs that had been in candidate status for years. The Regional Forester decided not to establish this RNA at that time.

Chapters 1, 2 and 3 of this assessment provide information on the current condition of ecosystems as a whole on the forest. By definition, the RNAs represent the more pristine end of the scale with regard to ecological integrity of these ecosystems. Past fire suppression has affected ecological conditions in many of the RNAs; however, it is not always feasible or wise to allow fires to burn under natural conditions in these areas. Ecological conditions are likely to move away from the natural range of variability without changes in fire management policies for RNAs.

Changes in climate have the potential to affect existing RNAs in the coming years. Changes in vegetation composition and structure of target elements, and even loss of the target element communities within the RNA areas, is possible depending on the degree and direction of climate change.

Invasive species, as discussed in Chapter 1 of this assessment, will likely continue to spread on the Sierra NF, possibly entering the lower elevation RNAs more than they already have. The overall lack of ground-disturbing activities may provide some resistance to invasion.

For more detailed information on Research Natural Areas see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1532-1638.

Forest Service Scenic Byways

The 70-mile Sierra Heritage Scenic Byway takes about four hours to drive and provides a memorable journey offering access to several resort towns, recreation areas, popular lakes, and impressive views. This corridor has many snow parks and access to popular off highway vehicle (OHV) routes, as well as scenic viewing opportunities. There is a trend toward increasing OHV use with a potential doubling in the next 10 -15 years. The Sierra NF has seen an increase of over 1,000 rides on popular trails in one year. Gas prices influence OHV use by concentrating trail riding to trails nearer to the population centers and the valley floor, while decreasing use of trails that are more remote and at higher elevation. This factor influences the use of the scenic byway.

The 100-mile Sierra Vista Scenic Byway meanders through the forest and highlights some of the most beautiful scenery and views of the Sierra Nevada Mountain Range. Sights along the byway which starts at 3,000 feet in elevation and climbs to more than 7,000 feet include Redinger Overlook, Jesse Ross Historic Cabin, Mile High Vista, Jackass Rock, Arch Rock, Mammoth Pool, Clover Meadow, Eagle Beaks, Portuguese Creek, the Balls, Globe Rock, Beasore Meadows, Cold Springs Summit, Fresno Dome, Kelty Meadow, Soquel Meadow and Nelder Grove of Giant Sequoias. Campgrounds along the byway are on a first come basis and are popular.

There is a recent trend toward improving amenities along the scenic byway through the use of resource advisory committee (RAC) grants and the development of a corridor management plant. The corridor management plan is currently under development. RAC grants are being used to upgrade parking facilities and toilets near Globe Rock. There is also a trend toward more utilization of the scenic byway which has been substantiated by anecdotal reports of lodging establishments along or close to the byway. These establishments report that their patrons are interested in activities available in the area and have been happy to discover the byway as a recreational opportunity. The upturn in use of the byway may be due to increased population growth in California and the valley. For more information on demographics see Chapter 6 of this assessment. This trend is expected to continue. Use of the byway by visitors has also been promoted through various publications. The Byway Association works to help publicize the trail and upgrade its amenities. The Byway Association is advocating additional signs along the byway to enhance tourism.

Additional tourism will enhance the economics of nearby communities of Oakhurst and North Fork by keeping tourist dollars spent on food, lodging and shopping in these communities. Maintenance of the byway has been sustainable. Fourteen miles of the byway are unpaved, which can discourage round trip travel.

For more detailed information on scenic byways see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1652-1693.

National Recreational Trails

The Black Point Trail is not located by a population center such as a city or town, therefore this trail primarily serves the Huntington Lake community and is not heavily used by the general public. The main draw is the beautiful vista at Black Point. As this trail's use is moderate and increasing, although not at a rapid rate, maintaining the trail to Forest Service standards is achievable with current funding (Burkindine 2013b).

Rancheria Falls National Recreation Trail is not well known, and therefore is less utilized than some other trails. This trail also mainly serves the Huntington Lake community. This trail's use is moderate and increasing at a moderate rate. As the Rancheria Falls Trail is designated as a national recreation trail and the Sierra NF showcases the trail because of its national status, its maintenance is given priority. This trail is maintained to standard. This trail is sustainable based on current trends (Burkindine 2013b).

The Kings River National Recreation Trail is six miles long however, the national recreation trail portion of the trail is three miles long. The trail is located in the King's River Special Management Area. This trail is not heavily used and is mostly used based on word of mouth recommendations. Its use is increasing but not at a rapid rate. Like the two trails described above, this trail's maintenance has been prioritized because of its status as a national recreation trail. The relatively low use of the trail allows maintenance costs to be fairly stable since human pressures on the trail are low to moderate. This trail is sustainable based on current trends (Burkindine 2013b).

The Lewis Creek National Recreation Trail is one of the most heavily used trails on the Sierra NF. Located near the city of Oakhurst, it is an easy one hour drive from Fresno. This trail is year around, as at least the lower portion is snow-free most of the time. Mountain bikers also use the trail. The population in the valley is increasing including the population within one hour's drive, making the Sierra NF a popular location to recreate for more and more people. With more use, more maintenance is needed to meet Forest Service standards. This typically is due to the impact of trail use on water bars (structures that help to direct runoff and control erosion). Damage to water bars leads to excessive erosion. Therefore the increasing use of the trail leads to a trend of increased trail maintenance. Since the Sierra NF has experienced a flat trails maintenance budget, maintaining this and other high maintenance trails may not keep pace with rising maintenance costs. This would lead to the trail not being maintained to Forest Service standards and a trend toward inability to sustain good watershed function (Burkendine 2013b).

Located in the Nelder Grove of giant sequoias, the one mile long Shadow of the Giants National Recreation Trail features interpretive signs exploring the natural history and surroundings of this the unique giant sequoia ecosystem community. The trends are similar to those described in the section above regarding the Lewis Creek National Recreation Trail (Burkendine 2013b). Also see the section of this chapter on Nelder Grove as those trends also influence the sustainability of this trail.

For more detailed information on national recreation trails see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 161-241.

Experimental Ranges and Forests

As neither the San Joaquin Experimental Range nor the Teakettle Creek Experimental Forest fall under the Sierra LRMP, they will not be addressed in this assessment report.

For more detailed information on experimental ranges and forests see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1,641-1,649.

Special Management Areas

The Kings River Special Management Area includes approximately 49,000 acres and portions of the Middle Fork, South Fork and the Kings wild and scenic river corridors in Fresno County. The Kings River Special Management Area is within the High Sierra Ranger District of the Sierra NF and the Hume Lake Ranger District of the Sequoia NF. The Sierra NF administers the area. For more detailed information on the Kings River Special Management Area see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 542-578 and 1,518-1,530.

The 1991 Kings River Special Management Area Implementation Plan incorporates two accepted processes of recreation management. The Recreation Opportunity Spectrum (ROS) system provides a means for classifying areas in relation to the types of recreation opportunity experiences that are or can be provided, and the settings in which they occur. The Limits of Acceptable Change process was used to develop strategies for managing use to maintain the desired ROS. The plan projected ten years into the future in the development of management directives, policies and actions.

Special Interest Areas

Special Interest Areas (SIAs) are established to protect, and, where appropriate, foster public use, study, and enjoyment of areas with scientific, scenic, historical, geological, botanical, zoological, or other special characteristics. Management activities within SIAs are less restricted than within RNAs. For example, roads, trails, and recreation or interpretive facilities may be built within SIAs to facilitate public use. Vegetative management may occur to the extent that it is compatible with the purpose and management objectives. Sierra NF SIAs include two designated and one proposed botanical areas, one historical area, and three designated and two proposed geologic areas.

For more detailed information on special interest areas see the July 2, 2013 snapshot of the Sierra NF Living Assessment Chapter 15, lines 1,695-1,902.

The 500-acre Carpenteria Botanical Area provides for education and study, as well as protection of this unique shrub. The area also provides protection to other native Sierra Nevada foothill shrubs not presently included within a botanical area.

Recreational uses are encouraged in botanical areas, especially with a focus on education about the botanical values of the area. Much of the viewing of Carpenteria and associated species occurs from turnouts along Highway 168 within the botanical area, or by hiking on rock outcrops where access is easier than in areas of dense chaparral. Local colleges have long used the Carpenteria Botanical Area for teaching about the chaparral and about Carpenteria during field trips on the Sierra NF.

The 520-acre McKinley Grove Botanical Area was established under the LRMP to preserve an isolated grove of giant sequoias for research and ecological study. Associated species include ponderosa pine, sugar pine, white fir and incense cedar. There are no specific restrictions on recreation. Only periodic harvesting of whitewood is prohibited. Mining and encumbrances are prohibited. New roads, trails or campgrounds will not be constructed. Prescribed fire for fuels management may be used to perpetuate fire dependent giant sequoias.

The 1,600-acre proposed Devil's Peak Botanical Area would protect the unique ecology, vegetation, and geology of the area benefiting three sensitive plant species: Yosemite onion, Congdon's woolly sunflower, and lewisia which occur in this area. This site is important for research and ecological study by naturalists and the scientific community. If established, a management plan would be written describing how the area would be best used for education and how the botanical values would best be sustained over the long term.

The rare plant populations at Devil's Peak are not directly near the lookout or roads or trails, but require a rigorous hike to access. A group of botanists and members of the California Native Plant Society monitored the populations in 2006 and found them to be in excellent condition. The botanical area is rocky and steep without obvious problems with invasive non-native plants or other impacts at this time. The only possible impact is illegal off-highway vehicle use, which might damage the native vegetation within the botanical area but would be unlikely to affect the rare plants due to the steepness of the slopes where they grow (Clines 2013).

The 1,400-acre Nelder Grove Historical Area contains 106 mature giant sequoias intermingled in a second-growth forest of Sierra Nevada mixed conifer forest (white fir, incense cedar, ponderosa pine, sugar pine, black oak, and canyon live oak). The area is rich in history from early logging activity between 1884 and 1893. Almost all trees that were under eight feet diameter breast height (dbh) were cut into lumber. The lumber was used for building construction and head gates on irrigation canals in the San Joaquin Valley. The area contains the Shadow of the Giants National Recreation Trail and the trail to the very large "Bull Buck" tree.

No vegetation treatment, including timber harvest or major fuels reduction projects, has occurred in this area since the mid-1990s. At that time, 60 trees were cut but there was no mechanism to remove these trees so they were left to rot. Although the sequoia trees do not drop a great deal of needle litter, limbs and twigs break off. Two recent weather events of heavy snow loads and winds have left an even heavier fuel load with some wood lying across old sequoia stumps. This has resulted in a significant amount of dead and downed wood covering the area. The policy of fire suppression has contributed to the heavy fuel load and reduced germination of redwoods. Germination has been negatively affected by the need for fire to open redwood pinecones and the heavy forest letter of pine needles and downed wood that make it hard for seeds to reach the soil and for germinated seeds to thrive (Smith 2013).

Historically there were disturbances to the ecosystem in the area including lightning ignited fires. These strikes caused fires that crept along the ground leading to thinning of trees and regeneration of the undergrowth. Since fire suppression has stopped fire in the area, the density of the trees and undergrowth in this area is not natural. Currently the understory cannot burn without damage to the sequoias, including the downed sequoia logs and the existing stumps. There is little new sequoia growth in the area.

Permission has been granted and resources provided to stack non sequoia fuels and wood 100 feet along each side of the trail. No trees are currently being mechanically removed. There is a plan for this work over the next ten years.

Visual character is poor due to the amount of fallen wood and the density of the trees which do not emulate pre-fire suppression conditions. Hiking off the trails is difficult due to the downed wood. There is a high level of recreation in the area including camping, day use and mountain biking. With the increasing population, use of this area would be expected to continue to rise which may result in additional campground and trail needs. Additionally the demographics of the changing population may also lead to use of this area differently that it has been in the past although this has not been identified.

With little treatment in this grove and continued fire suppression, the trend is toward an increasing threat to the grove from uncharacteristic wildfire which may even scorch fire resistant redwood trees and would likely severely damage most of the white wood (non-redwood) trees in the grove. The stacking being done creates a benefit only to the areas immediately adjacent to the trails.

Current area management precludes the development of new roads and trails in this area. Limitations on road building constrain the equipment that can be brought in to remove trees and debris. Limitations on burning constrain the amount of prescribed burning and pile burning that can eliminate downed or thinned wood.

The 338-acre Kings Cavern Geological Area includes three major cave systems with at least 16 entrances and up to 2,000 feet of passageways. This cavern system developed in marble bedrock, representing a metamorphosed remnant of sedimentary bedrock predating the intrusion of the granitic batholiths that formed the Sierra Nevada Range. Flowstone, soda straw stalactites, and draperies are among the cave features. Some cave formations are delicate and rare and need continued protection. A few other cave systems are found in nearby parts of the Sierra Nevada, but this is the most extensive and well-preserved cavern on the Sierra NF. Access is limited and distant from population centers. This promotes preservation of the cave features.

The 27-acre Courtright Intrusive Contact Zone encompasses a unique bedrock exposure in the Sierra Nevada Range. Its significance stems from many bedrock features of geologic interest found within a small, well-exposed, and readily accessible area. It is possible to see the contact between two of the largest granitic intrusion which formed the Sierra Nevada Range. The geological progression can be tracked from: (1) initial intrusion of the Dinkey Creek Grandiorite into pre-existing sedimentary rocks,; (2) intrusion of the Granite of Lost Peak; (3) deformation of these rocks, probably by fault movement; and (4) intrusion of the Mount Givens Grandiorite after deformation ceased.

The site offers recreation and education by interpreting the features, which are close to campgrounds and picnic areas and at a major trailhead into the John Muir Wilderness. Protecting the scientific value of the feature is equally important because students and teachers from major universities and professional societies visit the site.

The 640-acre Dinkey Creek Roof Pendant is a sequence of five sedimentary rock units metamorphosed by neighboring intruded granite. The rocks are folded and faulted, showing evidence of the spectacular forces involved when mountains are formed. Designation provided an opportunity for interpretive services to enhance the recreational experience of visitors and protect the scientific value of an important geological locality.

The 80-acre proposed Crater Lake Meadow Geological Area is a steep-sided exposure of basaltic rock, topped with a central depression containing a small wet meadow. The feature is an ancient volcanic pipe of basalt. About 3.5 million years ago, it served as a conduit for molten rock emerging from deep in the earth. The original outpourings were eroded by glaciation leaving only this resistant remnant. Granitic boulders deposited by glaciers dot the surface of the proposed site. Access is limited to a trail. Planned timber sales will provide unimproved roads to within a short distance.

There is a potential geological area in the Kaiser Wilderness with several small caves that vary from 33 feet to 860 feet in length. Field reconnaissance has discovered at least three different cave systems in the Kaiser Wilderness. These caves are all located in sinkholes at the bottom of drainages. Four of these caves are eligible for nomination as significant caves because of unique characteristics in geologic, hydrological and recreational features. Biological and cultural features have not been thoroughly conducted. The location of these caves is considered sensitive information under the Federal Cave Resources Protection Act of 1988.

Contribution the Plan Area Makes to Ecological, Social or Economic Sustainability

Areas have been designated on the Sierra NF to protect and utilize their special attributes. There were specific land types or ecosystems present in the plan area that, prior to designation: 1) were not represented or were minimally represented within the wilderness system or system of research natural areas; 2) had outstanding resources; 3) provided opportunities to highlight unique recreational or scenic areas in the plan area to provide for sustainable recreation opportunities; 4) provided a unique opportunity to highlight specific educational, historic, cultural, or research opportunities; or 5) were lands with known important ecological roles. Land areas that met these criteria have been designated on the Sierra NF.

Trail systems, including the PCT and other national scenic Trails, have many social and economic contributions. Trails are an invitation into nature allowing the appreciation of wild scenery. Forest landscapes inspire awe for their immensity, timelessness, and self-organized complexity. Trails through the Sierra NF are a refuge from industrialized civilization and its sights, sounds, and smells moving at a more natural pace that allows all our senses to work. Solitude and detachment from routine social pressures and distractions provide the setting for inward reflection and self-discovery.

Hiking allows a freedom of unconfined recreation along with a sense of belonging to the natural whole. Hiking can present a physical challenge leading to a sense of personal accomplishment. Experiencing the Sierra NF can lead to citizen ownership of, and investment in, resources of national significance.

As populations increase, the sustainability trails may be in question. While trail maintenance funding is flat or declining, partnerships have been an important source of trail maintenance. The Sierra NF's ability to engage the public and increase its partnerships will be a factor in determining the sustainability of these important social outlets.

The specific social, economic and ecological benefits of wild and scenic rivers provide managers with tools to protect free-flowing condition, protect and enhance of water quality and values, and, promote economic development, tourism, and recreational use. Wild and scenic rivers enhance social values by encouraging management that crosses political boundaries in recognition that all activities in the watershed may affect water quality, fish, wildlife, recreation and other values, as well as by promoting public participation and partnerships to conserve river values.

Additionally wild and scenic areas are an increasingly important resource in a time of significant climate change as they secure environmental flows through the federal reserved water right created to protect values. They also allow the application of climate forecasting and design strategies to protect river-related values and in-corridor development from the anticipated effects of reduced or exacerbated flows.

Wilderness areas contribute significantly to our nation's social, economic and ecological health and well-being. The benefits these areas provide are as diverse as the areas themselves. Wilderness areas are important sources of clean water and air. While the benefits of wilderness transcend boundaries, they are threatened by human activities outside wilderness. Wildlife and plant communities find high quality habitat with wilderness. Wilderness designations also provide for natural processes, including disturbances like fire, which are important to wildlife and plant communities. Wilderness is threatened by the introduction of non-native species, pollutants, and the suppression of natural processes.

The legacy of wilderness is passed on from generation to generation. Some people take once-in-a-lifetime trips that deeply affect them. Some people visit regularly, and are routinely refreshed in the wilderness. Some people will never visit wilderness yet value knowing that these places exist. Failure to preserve these areas limits future generation's inheritance and quality of life.

Wilderness was created for the use and enjoyment of the American people. Yearly, over 12 million people visit wilderness areas to hike, ride horses, hunt, fish, ski, float the rivers, take pictures, and stargaze. Many people who visit wilderness are inspired and humbled by the feeling of being part of something larger than themselves. Wilderness is a haven for self-discovery and rejuvenation. Wilderness areas are closed to motorized vehicles and mechanical forms of transportation, including mountain bikes. Trespass by these types of transportation threatens the solitude and primitive recreational opportunities for which they are designated (Bureau of Land Management 2013).

Forty four percent of the Sierra NF is wilderness. Staffing of wilderness rangers has been static and in some cases declining. Insufficient monitoring has been done to fully characterize the sustainability of wilderness. The Wilderness Stewardship Challenge scorecard indicates that four wildernesses on the Sierra NF may be of some concern as to the sustainability of aspects of wilderness character.

Inventoried roadless areas preserve lands that could be suitable for conservation as wilderness or other non-standard protections in a roadless condition. Similar to wilderness, this protection provides social, economic and ecological benefits. Limiting road-building in the inventoried roadless areas minimizes negative environmental impacts of roads construction, maintenance, and automobile traffic. Inventoried roadless areas expand the system of protected federal lands to include ecosystems that were not very well represented in the current system of national parks, wilderness areas, and preserves including lower to mid-range ecosystems and in many areas provides a needed buffer from areas of motorized use to lands designated as wilderness. Current Sierra inventoried roadless areas do not attract a great deal of recreational use and therefore tend to be socially, economically and ecologically sustainable, other than the issues plaguing ecological sustainability of the forest in general, like vegetation density.

Research natural areas contribute to ecological sustainability by permanently protecting and maintaining biological diversity. RNAs also contribute to social and economic sustainability. Three RNAs have been established on the Sierra NF and three others are candidates for establishment. The sustainability of RNAs has come into question. Across California, there is a question about how to manage fire on the RNAs. Work has been done toward recommendations for fire management, both suppression and post-fire rehabilitation and restoration. In many cases, the occurrence of fire is necessary to maintain the target

elements of the RNA, and whether or not fire suppression is desirable should be considered as part of the overall management of the RNA (Forest Service 2013). Climate change presents a special challenge since the baseline or reference area may change. Climate will also affect biotic populations directly. The desired condition is a network of research natural areas that represents the full diversity of ecosystems found across the region, 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 botanical feature to be researched and be protected from destruction such as climate change or fire. Redundant areas may be necessary (Forest Service 2013).

Scenic byways contribute to social, economic and ecologic sustainability similarly to the trails, although the experience may be less intimate and less physical. Scenic byways allow a different user group to have experiences with nature. Driving for pleasure is one of the most popular outdoor recreation pursuits in California and the country. Use of scenic byways also leads to economic benefits from tourism. The maintenance and usability of the Sierra Heritage Scenic Byway is stable and sustainable. Efforts are underway supported by Sierra NF partners to increase the use of the scenic byways, thereby increasing local tourism and enhancing the economic health of some rural communities.

Special interest areas (SIAs) contribute to social, economic and ecological sustainability by preserving, protecting and managing lands with special attributes for public use and enjoyment. Designation of lands as SIAs protects the lands 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 resources are especially vulnerable to disturbance. Once disturbed or damaged, the information lost is irreplaceable. Vandalism of cultural resources is a major concern.
This protection allows these special places to maintain their unique character of purpose for current learning opportunities and study as well as appreciation by future generations. Designation also can maintain safe access; provide adequate facilities at the sites and provide educational materials through maps and brochures enhancing social sustainability (Forest Service 2013).

Although most of the SIAs appear to be sustainable, some with intense public use and unique circumstances, such as Nelder Grove, may have challenges to be sustainable and continue to contribute to the social, economic and ecologic sustainability of the Sierra NF.

Information Gaps

Although the Sierra NF does have important information relating to designated areas, including a large body of on the ground experience with these important forest areas, there are some information gaps relating to some of the designated areas. The WSR corridor boundaries are not clearly established for the Merced and the Kings River and therefore acreages of these corridors within the Sierra NF are not available. Additionally an assessment of the impact of human activity in the wild and scenic river corridor is not available. Wilderness character monitoring in the Kaiser and other wildernesses is not available to establish a baseline for measuring trends. Determining the baseline and continued monitoring

will be necessary to evaluate the success of stewardship activities in preserving wilderness character. An assessment is currently underway to prioritize wilderness information needs and actions needed to address identified risks. However, this information is not available for incorporation into this assessment.

CONCLUSIONS

Chapter 1: Ecological Integrity

Ecological integrity of terrestrial ecosystems varies with location and elevation on the Sierra NF. At the highest elevations, in wilderness and subalpine and alpine, ecosystems are generally intact. There are some impacts from climate change, but they are limited. Trees are moving up in elevation and there are pending effects of climate change on increasing fire. Upper montane forests, meadows, and chaparral are in mixed condition of ecological integrity and these areas are among the most vulnerable to climate change. Red fir forest and meadows are tied to snowpack. Snowpack is declining and expected to continue declining. Fire suppression and limited forest management has led to some increases in forest density, and uniformity of structure and fuels. These effects will continue and with an increased risk of drought-related tree mortality, insect and pathogen outbreak, and uniformly intense, high severity, large wildfires. Mixed conifer and pine forests in the montane ecosystems have been most impacted by fire suppression and past management. These forests are home to key species of conservation concern including the fisher and California spotted owl. Forests are denser, large tree densities are reduced and forest structure is more uniform with reductions in snags, shrubs. This has decreased the overall biodiversity of song-birds, woodpeckers, small mammals, and understory plants adapted to light and fire. The foothill zone has been the most altered, as a result extensive human development and non-native invasive grasses.

Aquatic and riparian ecosystems have varied ecological integrity. Water quality and quantity are within the natural range of variability. These are at risk from climate change, including decreased precipitation and changes in seasonal timing. Extensive water development has reduced the habitat extent of some species, such as salmon, and changed the habitat of others. Riparian habitat is in various states of ecological integrity. Water development has decreased it in some areas through changes in water flow and timing. Fire suppression has impacted riparian habitat by increasing conifer density and decreasing riparian hardwood and herbaceous vegetation. This results in decreased habitat diversity for birds, bats, insects, and amphibians. Meadows have lowered water tables from overgrazing in the late 1800s, water development, road placement, and recreation. Current meadow management is more controlled but impacts remain.

Chapter 2: Assessing Air, Soil and Water Conditions

Air quality is in non-attainment status, per regulatory standards, for ozone. This has detrimental impacts on human and ecosystem health. Haze has reduced visibility in Class 1 air sheds in wilderness areas. Smoke is a health concern when uncontrolled wildfires are burning. Although prescribed fire and managed fire are the most effective tools for reducing potential smoke from wildfires, poor air quality limits their use. Soil has been modified in some areas, and in others is largely intact. There is risk from large, high intensity fires that can produce substantial soil erosion. This risk is increased by dense vegetation. Water is a highly valuable commodity for municipal use, power generation, and agriculture. Water systems are extensively developed, which has negatively impacted aquatic biodiversity. Water

systems are at risk from uniformly high intensity fire and interruption of use or damage to high voltage power transmission lines. Vegetation management to reduce the risk is limited in steeper areas to fire restoration because of equipment operation limitations and erosion potential from mechanical treatments. This causes conflict with air quality attainment.

Chapter 3: Assessing System Drivers and Stressors

Fire suppression and past vegetation management have led to increased forest density and fuel loads. Consequently, fires are more intense and uniformly severe, and forests are more vulnerable to insect and pathogen outbreaks and drought-related tree mortality. The rate of ecosystem restoration, whether fire or mechanical, is very low compared to the need. More climate change is expected. Warmer temperatures, along with more rain than snow are occurring. This change will intensify trends in fire, insect and pathogen outbreaks, and drought-related tree mortality. High ozone levels contribute to all of these factors, and decrease forest health. Invasive plant species are increasing, especially in the foothills. Once an invasive species dominates a site, fire patterns change and become more frequent and earlier in the season. Overall, drivers and stressors have changed substantially and have cascading effects on reducing sustainability of ecological integrity and ecosystem services. Based on current land allocations and associated management restrictions, active management can only occur on approximately 20 percent of the Sierra NF.

Chapter 4: Carbon

Climate change, shifted fire regimes, grazing, vegetation management, insect and disease, and population growth impact the amount of carbon the Sierra NF can store. California's national forests are expected to be net carbon sinks over the next several decades until around about the middle of this century. At that point, carbon losses from wildfire, disease, and other disturbances will exceed sequestration, and forests will become net emitters.

Chapter 5: At-Risk Species

There are currently 92 species identified as at-risk. Twelve are federally listed under the Endangered Species Act (5 as endangered, 3 as threatened, 2 as candidates, and 2 as proposed) and the remaining 81 are preliminary species of conservation concern. Of the preliminary species of conservation concern, more than half (46) are plant species. These species cover a wide range of ecological conditions although there is a concentration of species around a few key ecosystems such as: mature forests; aquatic, riparian and meadow systems; and gabbro or serpentine soils. Additionally some key ecosystem components such as: snags, down logs, riparian vegetation, and shrub fields are important for several at-risk species.

Key risk factors focus on climate change and how it may affect both the current and future distribution of habitat and habitat connectivity, in addition to how it will directly affect species sensitive to changes in hydrology, temperature, or the seasonality of weather. Fire is another key risk factor primarily affecting the short and long term availability and quality of habitats. Continuing and past impacts from livestock grazing is a key risk factor for several species, primarily those associated with aquatic systems, riparian areas and meadows. Finally, habitat fragmentation and disturbance from human activities are key risk factors for several species, particularly as human population grows and drives increased uses and developments in and adjacent to the forest.

Chapter 6: Assessing Social, Cultural and Economic Conditions

People are becoming increasingly disconnected from nature and outdoor experiences, particularly those who live in urban areas. Many people from culturally diverse backgrounds are under-represented as visitors on national forests and other public lands. This disconnect may grow as populations, urbanization and cultural diversity increase. The three-county area where the Sierra NF is located generally faces greater challenges to human well-being than California or the Sierra Nevada bio-region as a whole. Sierra NF communities are increasingly at risk from catastrophic wildfires. Total employment in timber sector jobs has declined in the three-county area. Water flowing off of the Sierra NF is extremely important to the economy of the San Joaquin Valley, which may be adversely impacted by the effects of climate change, population growth, and increased demand and competition for water.

Chapter 7: Benefits to People

Continued enjoyment of the benefits obtained from key forest ecosystem services is vulnerable to the threat of uncharacteristic fire. Additionally, the increase in fire spending reduces the Sierra NF's ability to take care of other management needs that also threaten the sustainability of these services.

Chapter 8: Multiple Uses -- Fish, Wildlife, Plants

Climate change is changing the timing, duration, and magnitude of stream flows, which is affecting fish species. Deer populations are slowly declining. Data on other hunted species are not available. Floral diversity and abundance depends on fire return intervals within the natural range of variation. Large departures from the natural range of variation occur on the Sierra NF, primarily in the montane zone.

Chapter 8: Multiple Uses – Range

The Sierra NF supported heavy sheep grazing between the late 1800s and the 1950s. Overgrazing during this time was widespread and erosion was extensive. More careful management since then has improved allotment conditions. Sheep grazing has been replaced by cattle grazing. The levels of grazing have been greatly reduced. Today, annual grasslands composed primarily of non-native species occupy what was once pristine native grassland. Introduced annuals are considered "naturalized" plant species and so are managed for, rather than as invading species which would be characteristic of poorer range sites. Livestock grazing is likely to be sustained within the planning area over the next 20 years based on recent past site-specific range analyses.

Ecological restoration will contribute to the sustainability of grazing on the Sierra NF. Meadow restoration will remain a priority. Livestock grazing promotes the maintenance of open space rather than urban development in the area as permittees are required to own base property ranches. An assessment is in progress between the Forest Service and University of California Davis to estimate trends over the last20 years. Over 800 monitoring sites have been established on the national forests in California since 1999. Results from this study are expected in the fall of 2013 which will provide a more meaningful assessment of rangeland condition and trend and response to grazing management, as well as to weather and other factors. The results of this study are expected to be incorporated in the final Sierra NF Assessment.

Chapter 8: Multiple Uses – Timber

Trends indicate warmer and drier growing conditions leading to increased tree mortality. There will be a need to improve forest resilience and critical wildlife habitat. Mechanical treatments will contribute to increasing the pace and scale of ecological restoration where appropriate. These treatments will be used along with prescribed burning and natural change agents such as wildfire to effect needed changes.

Timber harvest on the Sierra NF was over 160 million board feet (MMBF) in 1989 and has steadily been reduced over time to 12.5 MMBF. The Sierra NF moved away from even-aged reforestation management 20 years ago to stand maintenance thinning harvests intended to control density and growth of stands. Timber industry representatives say that approximately 25,000 mbf will be needed from the Sierra and Sequoia National Forests for the last remaining local sawmill infrastructure south of Yosemite National Park. Several wildland urban interface fuels reduction and restoration projects are underway and more are planned. These projects are intended to create strategically located treatment areas to intercept wildfire originating in the more fire-prone foothills below. Maintenance of business infrastructure to support Forest Service restoration goals is a critical concern for the Sierra NF, the tribes, other agencies and public utilities. Markets for excess or hazardous timber help defray the costs of required maintenance for facilities, roads, and fuels management.

Chapter 9: Recreation Settings, Opportunities and Access, and Scenic Character

Population growth in the Sierra Nevada and increasing demand for outdoor recreation in general has resulted in more people visiting the Sierra NF. This may be having ecological impacts, particularly through dispersed recreation, though little existing information is available. While demand is going up, Forest Service budgets are decreasing. However, partnerships with utility companies are refurbishing selected recreation facilities. Fewer resources are available to maintain and operate existing recreation facilities, develop new opportunities, or provide management of dispersed recreation. Because of the large departure of existing vegetation and fire regimes from the natural range of variation on the Sierra NF, scenic stability is low. This is reducing the sustainability of scenic character and valued scenic attributes. People may become increasingly dissatisfied with the recreation opportunities provided if the forest does not have the capacity to manage its recreation facilities and opportunities and is unable to meet the public demand. Increasing cultural diversity is expected to further influence visitor preferences and satisfaction.

Chapter 10: Energy and Minerals

New hydroelectric facilities are unlikely to be added on the Sierra NF; however, there are plans for improvements to existing projects. It is unlikely that transmission corridors will be developed in the future on the forest. Wind or geothermal energy will likely not be produced on the forest during the current planning horizon. Most vegetation management projects developed on the forest are further away than the pre-2008 commercial haul radius of 25-50 miles to electrical or ethanol processing plants. Long haul distances and relatively low fuel values limit the cost effectiveness of contracting for forest biomass for fuel production. A project under consideration may allow for a limited amount of biomass utilization in the future. Mining overall on the Sierra NF has declined. However, gold mining on the northern part of the forest continues by many small operators who are motivated by current high gold prices.

Chapter 11: Infrastructure

The Sierra NF is one of the most popular national forests in the United States. The transportation system offers the many opportunities for utilizing the Sierra NF, including timber management, fuel treatments, access to private in-holdings, fire control, utility management, special uses, recreation and harvesting of special forest products. It also provides the access necessary to implement ecological sustainability activities. Major roads are in fair condition, but less travelled, rougher roads are becoming brushed over and make normal pickup access difficult. The reducing road budget will result in the reduction in the sustainability for the road system.

The forest's fire and administrative facilities provide work areas for the people charged with the administration of the Sierra NF. The facilities budget has dropped, making it more difficult to sustain the condition of the facilities to an adequate level.

There are 275 buildings classified as recreation; 33 buildings classified as range management and over 400 historic structures. Forest staff maintains these to the best of their ability, but there is a backlog of deferred maintenance. Trails are maintained to standard through the use of volunteers and partners.

Chapter 12: Areas of Tribal Importance

Tribes are concerned about the continued protection of and access to culturally important resources and areas of tribal importance. Population growth and increasing pressure on public lands for recreation, water, and other resources may lead to increasing conflicts with Sierra NF uses critical for maintaining tribal traditions and culture. Tribal traditions and culture are dependent on the health of ecosystems, including disturbance regimes within their natural range of variation. Climate change could further impact resources and areas important to tribes.

Chapter 13: Cultural and Historical Resources and Uses

Cultural resource sites are at risk. In an effort to avoid impacting these resources, fuels and vegetation treatments were excluded from these sites for decades, causing excessive build-up of fuel. Fire suppression activities can also impact cultural resources. Increasing population growth and recreation demand, as well as higher desire for heritage tourism are challenges to the sustainability of cultural resources and to the ability of the plan area to meet public needs. With declining federal budgets, the Sierra NF has been challenged to keep up with the work needed to maintain the road system to safety and environmental standards. This has resulted in a backlog of deferred maintenance. Increasing illegal activities are threatening the ability of the forest to protect cultural and historic resources.

Chapter 14: Lands

People have a strong connection with public lands and the Sierra NF. Connections are based on generations of use and exploration, as well as traditions that are still in the making. The trend is for increasing population, which may create more demand to develop the private lands within the forest. More demand will be placed on public land for community uses such as water systems and sewer facilities. Land use for private land located within the Sierra NF is under the control of the local county. The county defines the appropriate type and intensity of use in its County General Plan and administers this direction through zoning ordinances. Requests for further hydroelectric developments at existing facilities to help meet the growing energy demands of California are expected.

Chapter 15: Designated Areas

As populations increase the sustainability of trails may be in question, making partnerships an important part of how the Forest Service accomplishes its work. Changing human dynamics influence the resources near areas where people congregate or use the land. These heavier human pressures may lead to less sustainability in dispersed camping areas. A large part of the Sierra NF is wilderness. In some areas, insufficient monitoring has made a full characterization of sustainability of the wilderness challenging. Four Sierra NF wildernesses may be of some concern for sustainability of aspects of wilderness character. Current forest inventoried roadless areas do not attract a great deal of recreational use. These roadless areas tend to be socially, economically and ecologically sustainable, other than the issues the forest is experiencing in general, like vegetation density. The sustainability of research natural areas (RNAs) is in question as a result of fire management and climate change concerns, and additional RNAs may be necessary. With the help of partners, efforts are underway to increase the use of the scenic byways, thereby increasing local tourism and enhancing the economic health of some rural communities.

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CHAPTER 15

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HELPFUL LINKS

Current Sierra NF Land and Resources Management Plan
http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5373730.pdf

US Forest Service Pacific Southwest Region Plan Revision website
http://www.fs.usda.gov/main/r5/landmanagement/planning

USFS Plan Revision website
http://www.fs.usda.gov/planningrule

Sierra Cascades Dialog
www.fs.usda.gov/goto/r5/SierraCascadesDialog

Our Forest Place
http://ourforestplace.ning.com/

The Living Assessment
http://livingassessment.wikispaces.com/

PSW Science Synthesis
http://www.fs.fed.us/psw/publications/reports/psw_sciencesynthesis2013/index.shtml

History page for Sierra Nevada Forest Planning
http://livingassessment.wikispaces.com/Brief+History+of+Sierra+Nevada+Forest+Planning

USFS Pacific Southwest Region Ecological Restoration
http://www.fs.usda.gov/detail/r5/landmanagement/?cid=STELPRDB5308848

Forest Service Road Accomplishment Reports
http://www.wildlandscpr.org/2006-and-2007-road-accomplishment-reports-rars

Forest Service Travel Management
http://www.fs.usda.gov/main/r5/recreation/travelmanagement

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Document Number: R5-MB-269