Chapter 2: Alternatives, including the Proposed Action

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Chapter 2: Alternatives, including the Proposed Action

2.1. Introduction

This chapter describes and compares the management alternatives considered in detail. It focuses on differences in management direction among the alternatives. It also describes additional alternatives that were initially considered but eliminated from further study and provides rationale for their dismissal.

2.2. Considering Uncertainty and Risk in the Decision

Uncertainty and *risk* are central considerations in decisions about natural resource management. A discussion of uncertainty and risk has been included here to increase understanding of the way these concepts factor into decisions concerning management of the national forests of the Sierra Nevada. Lawrence C. Walters, Ph.D., Peter J. Balint, Ph.D., Anand Desai, Ph.D., and Ronald E. Stewart, PhD., prepared the following material. The concepts described below set the stage for reviewers of this final supplemental environmental impact statement (SEIS) and provide important context for the resource issues to be addressed in the forthcoming decision.

A Consideration of Uncertainty and Risk in the Sierra Nevada Case

Regarding uncertainty and risk as they apply to the Sierra Nevada case, we find that:

- Uncertainty is a neutral analytical property of an event, relationship, phenomenon, or other important consideration that may be reduced through better science, but generally cannot be eliminated.
- Defining risk is fundamentally an expression of values and power.
- The important short-term risks facing the Forest Service are related to decision processes, not ecological outcomes.
- The Sierra Nevada management decision is a wicked problem.

Nature of Uncertainty

Uncertainty is a neutral analytical property of an event, relationship, phenomenon, or other important consideration, which may be reduced through better science, but generally cannot be eliminated.

In this context, we mean by *uncertainty* the likelihood of the occurrence of an event, relationship, phenomenon, or other important consideration. This likelihood of occurrence may be unknown, or may have a distribution of possible values, but it is not under the immediate control of Forest Service decision makers. In describing uncertainty as value neutral, we wish to highlight two important points:

- Uncertainty is used to describe probabilistic events, whether or not it is possible to quantify those probabilities. For example, the distribution of naturally occurring fire events may be calculable, and, therefore, the probability of fire during a specific time interval may be estimable. The likelihood of important budget changes as a result of shifts in national public policy priorities during the next 50 years may not be estimable. In both cases, however, *uncertain* is the analytical term used to describe the events.
- Uncertainty does not inherently involve a value position on the part of the analyst or decision maker. The probability of occurrence of a lightning strike, for example, is independent of attitudes toward fire hazard, owl habitat, or any other value position. In this sense, uncertainty is a neutral concept.

Three broad categories of uncertainty in the decision context face the Forest Service: scientific, administrative (or implementation), and stochastic.

To say that something is scientifically uncertain within the context of the Sierra Nevada decision problem is to acknowledge that forests are complex systems and that our knowledge of them is incomplete. As a result, no one can state with certainty the long-term outcome of any given management strategy, including maintaining the status quo. Examples of key areas of scientific uncertainty include:

- the acreages of old-growth forest and old-growth forest habitat determined under the various alternatives as projected by vegetation models;
- the population of old-growth dependent species associated with these projected acreages and the resulting probabilities of viability as projected by the California Wildlife Habitat Relationships Model and viability models; and
- the annual or decadal acreages burned and severity of burn as projected by such models as FLAMMAP, SPECTRUM, and FARSITE.

Scientific uncertainty is often expressed as a calculated or estimated confidence interval around a

predicted value or outcome.

Administrative or implementation uncertainty refers to the vagaries of managing in a political environment in which public goals and priorities, societal needs and conditions, and organizational capacities change over time. Finally, stochastic uncertainty refers to those events that are largely random, unpredictable, and uncontrollable, such as lightning-caused ignitions or random changes in species populations.

Each of the factors is associated with specific uncertainties. In addition, the assessment of outcomes by stakeholders also involves uncertainties, as stakeholder perceptions, values, and priorities may shift over time.

Obviously, there is much that is uncertain and largely uncontrollable in this decision environment. While it is true that some uncertainties can be reduced over time through better science and organizational learning, many if not most uncertainties cannot be eliminated altogether.

The Uncertainty Dilemma

In describing and representing the scientific and stochastic uncertainties inherent in the Sierra Nevada management decision, analysts face a dilemma. On one hand, simple and accessible characterizations of the multiple uncertainties are likely to be misleading, biased, or wrong. One example may serve to make this point. Recent graphs generated by the Sierra Nevada Forest Plan Amendment (SNFPA) Review Team depict likely outcome trajectories of different management strategies over the next 140 years as lines. Objections were raised that such depictions may be misleading because they suggest that these trajectories are or can be known with certainty, or at the very least that depicted differences are real and meaningful. Those objecting argued that confidence intervals should be placed around each line, and that doing so would likely show that depicted differences in expected outcomes are significantly more uncertain than the initial graphs suggest. Whether or not the objection is valid, the point remains that lack of detail was seen to be at least misleading, likely biased, and perhaps even wrong.

But the potential remedy poses its own challenges. Detailed characterizations of uncertainty are likely to be difficult to understand and present and, consequently, may not be useful to the public or to decision makers. There is no scientific or technical solution for this dilemma. The resolution focuses on the decision processes employed. To be effective, such processes must tightly integrate analysis and broader deliberation, and should allow all participants to understand where scientists agree, where they disagree, and where their relative certainty ends (Stern and Fineberg 1996).

Defining Risk

Defining risk is fundamentally an expression of values and power.

Risk is a concept with a long pedigree in a variety of disciplines, but in virtually all technical discussions, risk is represented as having three components:

- one or more potential stressors (sometimes called hazards);
- a probability that these stressors will occur (often called exposure); and
- the likely adverse effect that will result if the stressors do occur.

It is common to compare risks based on the product of the magnitude of the loss that will occur and the probability of its occurrence. Such calculations are referred to as “expected values.” In one recent example, a panel of the National Academy of Public Administration (NAPA) (Fairbanks et al. 2001) found that many federal risk assessment methods consider mostly the magnitude of hazards. The panel argues that it is necessary to develop methods that clearly include all three components of risk:

- Hazard, e.g., an area's fuel loading and dryness conditions;
- Risk or exposure, e.g., the probability of ignition; and
- Value, e.g., the physical, social, and economic costs of the potential damage.

An important observation regarding the role of value judgments in assessing risk is also made by Slovic (2000) and is incorporated in a recent study by the National Research Council (NRC) (Stern and Fineberg 1996). In any characterization of risk, these studies argue, two critical value judgments are at least implicit. First, there is the judgment that a particular process or outcome merits serious attention. The decision to focus on wildland fire hazards or old-forest owl habitat, rather than, say, the economic vitality of adjacent communities or the potential harms to black oaks, is a value judgment made by key actors. Because of the political power and influence of those key actors, one set of values prevails in characterizing the risks in a given decision. Other actors at different times could have made, and have made, different judgments.

Second, there is the judgment about what constitutes an unacceptable level of the outcome dimension. To say that some number of acres of stand-destroying fires is unacceptable reflects again the values of the decision makers. Between these two judgments, there is much room for analysis in modeling, measuring, and calculating; but these important analytical efforts should not obscure the central observation that focusing on some outcomes and not others, and on some outcome levels and not others, is a reflection of the value judgments and priorities of those making the decision. Again, which perceptions prevail in determining acceptable threshold levels of risk is a function of the influence of key actors. Our point is simply that these choices are neither objective nor purely scientific, nor could they be.

Risks Facing the Forest Service

The important short-term risks facing the Forest Service are related to decision processes, not ecological outcomes.

The NAPA discussion is useful in helping to characterize the risks facing the Forest Service in the Sierra Nevada, which are somewhat broader than fire management:

- *Long-term risk*: given observed ecosystem conditions, existing external human factors, and future natural events and processes, the probability that any particular adopted management strategy will result in a preponderance of outcomes judged undesirable by the majority of stake-holders over the long term (beyond 10 years). In addition to long-term risk, the Forest Service faces important short-term risks as well.
- *Short-term risk*: given observed ecosystem conditions, existing external human factors, and future natural events and processes, the probability that any particular adopted management strategy will be seen as undesirable by the majority of stakeholders over the near term (10 years) because it
  - results in a preponderance of undesirable outcomes,
  - violates accepted historical precedents,
  - violates widely held principles and standards of practice, or
  - violates broadly held social preferences.

What emerges from this characterization is the observation that short-term risks involve much more than just concern about uncertain outcomes or the products of the decision. While stakeholders are certainly concerned with ecological outcomes, many are willing to accept modest short-term habitat losses if potential long-term gains are great enough. Further, in the short run, none of the vegetation models or fire projections shows a significant difference among alternatives in ecological outcomes. If it is true both that stakeholders are willing to consider short-term tradeoffs, and that alternatives under consideration are

indistinguishable in their short-run outcomes, then the focus of short-term risks must shift to concerns with the decision process. Attention must be paid to process, or the decision maker runs the risk of failing even though the likelihood of desirable long-term outcomes is enhanced. And this makes the *risk dilemma* all the more relevant.

The Risk Dilemma

How people perceive risk depends on

- what they value,
- how the risk is framed, and
- their level of trust in the responsible organization or institution.

It is well known, for example, that there is an inverse relationship between perceived risk and perceived benefit, and the relationship is linked to an individual's general affective evaluation of a hazard. If an activity is "liked" people tend to judge its benefits as high and its risks as low. If the activity is "disliked" the judgments are the opposite—benefits tend to be perceived as low while risks are perceived as high (Slovic 2000).

Further, and perhaps even more important, every way of presenting risk information is a *frame* that can shape the judgments of participants in a risk decision. If the issue is framed in a positive light, people are more likely to dwell on the positive aspects of the decision, and vice versa. One often cited example is the observation that summarizing medical risks in terms of mortality rates yields very different perceptions compared to when the same information is presented in terms of survival rates. If a given treatment is described as having a mortality rate of 10%, for example, it is perceived very differently than if the same treatment is said to have a survival rate of 90%. The evidence also shows that experts are not immune to these framing effects. The effect is as strong when subjects are physicians as when they are lay people. As the NRC report concludes:

> Numerous research studies have demonstrated that different but logically equivalent ways of summarizing the same risk information can lead to different understandings and different preferences for decisions (Stern and Fineberg 1996, p. 57).

It should be noted that this is not an issue that can be resolved with better science. There is no scientific way to determine that one summary of risk is more accurate or less biased than another when both accurately reflect the data. Consequently, the problem of generating a single unbiased summary of risk information to meet the needs of participants in a risk decision has no purely technical solution.

As with uncertainty, the resolution of this dilemma focuses on the decision processes employed. In this light, it is also important to note a corollary to the affective evaluation principle mentioned above: if participants trust the organization presenting the risk information, they are more likely to accept the characterization. And the level of trust is a byproduct of the decision process. Experience in a variety of settings suggests that such trust is easily damaged and difficult to restore.

Wicked Problem

The Sierra Nevada management decision is a wicked problem.

Clearly, some public problems are more difficult to resolve than others. Renn (1995) suggests that environmental debates operate on three levels of complexity, and that ecological risk assessment has *decreasing utility* as an input into policymaking as levels of complexity and conflict increase. For straightforward problems, scientific analysis can serve as a basis for policymaking with little controversy. At a medium level of complexity, public trust in the implementing institutions and their technical

expertise is required. At the highest level of complexity and conflict, profound social and cultural values come into play, and stakeholder involvement is essential. In these most complex cases, the processes of defining shared values, common goals, desirable outcomes, and acceptable risks become political. Consequently, technical analyses alone, which do not integrate social values and deliberation, cannot provide an adequate decision-support framework.

To make this point more clearly, it is helpful to consider two dimensions of any decision: the state of necessary knowledge and the level of agreement on guiding values. Given these characteristics of a decision environment, there are four possible scenarios. If the knowledge base underpinning an issue is well understood and generally accepted, and the agreement on values among stakeholders is high, then decision-making is easy and stakeholders may be comfortable with an agency-expert or authoritative strategy.

If agreement on values is low, but the science is well understood, then the focus is on dialogue among the stakeholders, guided by the science, to try to understand and resolve the value differences. When the science is uncertain and there are important gaps in the knowledge base, but the stakeholder agreement on values is high, then the focus is on getting the science issues resolved, with oversight and engagement by the stakeholders when needed to assure that their values are being reflected in the science and decision-making. But when both the science is uncertain and the agreement on values is low, then the issue becomes a wicked problem, and significant dialogue among scientists, stakeholders, and decision makers is needed.

Some of the key characteristics of wicked problems are (Allen and Gould 1986):

- The definition of the problem is in the *eye of the beholder*; that is, each stakeholder defines the problem differently and therefore there is no single correct formulation of the problem.
- Outcomes are not scientifically predictable.
- The decision maker cannot know when all feasible and desirable solutions have been explored.
- The resources of ecosystems, communities of interest, funds, organizational capabilities, etc., combine with stakeholder demands in idiosyncratic ways; therefore, any solution is likely to be *one-shot* and unique.
- Solutions are generally better or worse, rather than true or false.

It is our firm belief—based on the risks and uncertainties associated with all aspects of the decision framework and the lack of a clear consensus on public values and perceptions of risk—that the Sierra Nevada planning effort is a classic wicked problem. This means there is no single correct response, some responses are better than others, and the Pacific Southwest Region must cope with the complexities and ambiguities associated with wicked problems.

2.3. Alternatives Considered in Detail

Nine alternatives are considered in detail in this SEIS: the no action alternative (Alternative S1), the proposed action (Alternative S2), and seven action alternatives from the SNFPA FEIS (Alternatives F2-F8). The no action alternative (Alternative S1) continues management in the 11 Sierra Nevada national forests consistent with the SNFPA ROD of January 2001. Alternative S2 incorporates specific changes to the SNFPA ROD to:

- pursue more aggressive fuels treatments while maintaining old forest conditions and species at risk,
- improve compatibility with the National Fire Plan to ensure that goals of community protection and forest health are accomplished,
- implement the Herger-Feinstein Quincy Library Group (HFQLG) Recovery Act pilot project to the fullest extent possible,
- reduce unintended and adverse impacts on grazing permit holders,
- reduce unintended and adverse impacts on recreation users and permit holders, and
- reduce unintended and adverse impacts on local communities.

Alternatives F2 through F8 incorporate the fire and fuels reduction strategies and standards and guidelines described under Alternatives 2 through 8, respectively, in the SNFPA FEIS.

The following sections provide detailed description of Alternatives S1 and S2. Alternatives 2 through Modified 8 of the FEIS are briefly described here as Alternatives F2-F8. Readers can also refer to the FEIS, volume 1, chapter 2, pages 83-164, for a more detailed description of these alternatives.

2.3.1. Common Elements of Alternatives S1 and S2

Fire and Fuels Management, Old Forest Ecosystems, and Associated Species Conservation

Alternatives S1 and S2 share overarching goals for fire and fuels management that include protecting communities and forests from the impacts of large, severe wildfires; changing fuels condition classes; and meeting ecological goals for re-introducing fire. Both alternatives envision a collaborative approach to the management of hazardous fuels in and around communities coupled with the strategic placement of area treatments across broad landscapes. Naturally occurring wildfires would also be used to achieve fuels reduction objectives. All initial treatments would be completed over a 20 to 25-year period. Treated areas would be maintained over time to ensure that fire behavior objectives continued to be met.

Alternative S1 and S2 have overarching goals for old forest ecosystems and associated species that are aimed at protecting, increasing, and perpetuating old forest conditions. These alternatives would maintain habitat in perpetuity that is capable of supporting well-distributed, viable populations of old forest-associated species across the Sierra Nevada national forests.

Approach for Modifying Wildfire Behavior across Broad Landscapes

The fire modification strategy adopted in the SEIS is based on the theory that disconnected fuel treatment areas overlapping across the general direction of fire spread will be effective in changing fire behavior. Research conducted by Dr. Mark Finney (1999) suggests that, even outside of treated areas, fire spread rates can be reduced if the fire is forced to flank areas where fuels have been modified. Hence, treated

areas would function as “speed bumps” to slow the spread and reduce the intensity of oncoming fires. The overall effect is to reduce damage to both treated and untreated areas and the temper the consequences of large, uncharacteristically severe wildfires. Follow-up treatments in these areas are important to prevent grass and shrub colonization that would increase burn rates over time.

Dr. Finney’s research findings indicate that, given an effective treatment area shape and pattern, only a fraction of the landscape needs to be treated and maintained to produce the desired change in wildfire behavior over the entire landscape. This hypothesis underpins the fire and fuels strategy in Alternatives S1 and S2. Although computer modeling supports Dr. Finney’s hypothesis, the approach has not been tested on an actual landscape. Alternative hypotheses and the risks and uncertainties associated with them are discussed more fully in chapter 4.

An estimated 7.5 million acres in the eleven Sierra Nevada national forests are considered to be at high to very high fire risk. (Refer to the fire hazard and risk maps in the SNFPA draft environmental impact statement [DEIS] and the SNFPA FEIS [volume 2, page 256].) Fuels treatments would be located within these areas of the Sierra Nevada national forests. Alternatives S1 and S2 include the strategic placement of area treatments, ranging in size from 50 to over 1,000 acres (generally averaging between 100 to 300 acres), across landscapes to interrupt fire spread and thereby reduce the size and severity of wildfires.

Design Criteria for the Pattern of Area Treatments

Under Alternative S1 and S2, managers would determine the size, location, and orientation of fuels treatments at a landscape-scale. Managers would use information about fire history, existing vegetation and fuels condition, prevailing wind direction, topography, suppression resources, attack times, and accessibility to design an effective treatment pattern. The spatial pattern of the treatments would be designed to reduce rate of fire spread and fire intensity at the head of the fire.

In planning landscape-level treatment patterns, managers would incorporate those areas that already contribute to modification of wildfire behavior, including timber sales, burned areas, bodies of water, and barren ground. Managers would identify gaps in the landscape pattern where fire could spread at some undesired rate or direction. Treatments (including initial and maintenance fuels treatments) would be used to fill identified gaps. Alternative S2 includes additional design criteria and resource considerations for managers to use in planning the layout of area treatments.

Land Allocations

Both Alternatives S1 and S2 use the following land allocations (outside of the HFQLG pilot project area) as part of an overall strategy for conserving old forest ecosystems and species and managing fire and fuels:

- California spotted owl and northern goshawk protected activity centers (PACs),
- California spotted owl home range core areas (HRCAs),
- the WUI,
- old forest emphasis areas,
- southern Sierra Nevada fisher conservation areas, and
- general forest.

The two alternatives differ in the specific management direction that applies within each land allocation. A ranking order is assigned to land allocations, and management direction for a higher ordered land allocation pre-empts direction for another land allocation when two (or more) allocations overlap on the ground. The ordering is similar in Alternative S1 and S2 and is described in more detail under each alternative.

2.3.2. Alternative S1 - No Action

Theme and Overall Management Approach

The no-action alternative (Alternative S1) would continue management in the eleven Sierra Nevada national forests consistent with the SNFPA ROD. This alternative reflects concerns that impacts from mechanical fuels treatments pose greater risks to habitats, particularly in the short-term, than risks posed by wildfires. Alternative S1 involves a cautious approach for conducting activities in habitats for sensitive species, particularly species associated with old forest ecosystems. Alternative S1 includes standards and guidelines for retaining canopy cover and limiting the sizes of trees that can be removed during fuels treatments, and for imposing limited operating periods on activities in the vicinity of certain species' nest and den sites. Because of specific stand-structural retention standards, fuel treatment objectives may be compromised in landscapes with high proportions of suitable California spotted owl habitat (FEIS, volume 2, chapter 3, page 305). Under Alternative S1, vegetation treatments are limited to fire hazard reduction and maintenance of treated areas.

The no-action alternative also provides direction for limiting and, in some cases, eliminating grazing from habitat that is or has been occupied by the Yosemite toad or willow flycatcher. This alternative requires limited operating periods for all new resource management activities in the vicinity of California spotted owl and northern goshawk nest sites and forest carnivore den sites. Limited operating periods may apply to existing recreation and road and trail use, if analysis of proposed activities indicates that they are likely to result in nest or den site disturbance.

Land Allocations

Land allocations under Alternative S1 are ranked so that management standards and guidelines for a higher ranked land allocation pre-empt direction for lower ranked land allocations, where overlap occurs. However, because management direction is generally based on individual stand conditions, most of the standards and guidelines for mechanical fuels treatments are the same for California spotted owl HRCAs, WUI threat zones, old forest emphasis areas, and general forest. When differences occur, land allocations for Alternative S1 are ranked as follows:

(a) California spotted owl and northern goshawk PACs,

(b) WUI defense zones,

(c) WUI threat zones (where there is sufficient suitable owl habitat),

(d) California spotted owl HRCAs, WUI threat zones (where there is <u>not</u> sufficient suitable owl habitat), old forest emphasis areas, and general forest.

This ranking means that where a PAC overlaps another land allocation, standards and guidelines for the PAC supercede standards and guidelines for the overlapped land allocation.

Standards and Guidelines for Area Treatments

Alternative S1 includes standards and guidelines that specify either (1) the allowable types or extents of vegetation treatments in certain areas or (2) limits on amounts of vegetative material that can be removed through mechanical treatments. These standards and guidelines are designed to (1) mitigate the potential risks to old-forest-associated species and their habitats and (2) conserve likely important components of habitat for old-forest-associated species, such as stands of mid and late seral forests with large trees, structural diversity and complexity, and moderate to high canopy cover.

Prescribed burning is the only treatment option for PACs outside of defense zones. Limits are place on the total *number* of PACs in the bioregion that could be directly affected by fuels treatments. Vegetation treatments may intersect up to 5% of all PACs in the bioregion per year and 10% per decade. Standards and guidelines for old forest emphasis areas and California spotted owl HRCAs encourage the use of prescribed fire over mechanical treatments.

Standards and guidelines for mechanical treatments limit the sizes of trees and amount of canopy cover that can be removed. In addition, a portion of each stand must remain untreated. Management direction is applied on a stand-by-stand basis. As a result, the existing stand condition, rather than the land allocation, generally dictates which standards and guidelines apply.

With some exceptions (Table 2.3.2a), mechanical treatments in areas outside of the defense zone are limited to (1) removing trees having diameter at breast height (dbh) of less than 12 inches, and (2) reducing the canopy cover of dominant and codominant trees by no more than 10%. Alternative S1 does not place restrictions on the amounts of material removed through prescribed burning.

A complete set of standards and guidelines for Alternative S1 is provided in Appendix A and is included in the SNFPA ROD.

Table 2.3.2a. Exceptions to 12-inch Diameter and/or 10% Canopy Cover Reduction Limits for Mechanical Fuels Treatments.

Stand Condition and Land Allocation	Standards and Guidelines
All CWHR size classes in defense zones	Mechanical treatments may remove trees up to 30 inches dbh (24 inches dbh in the eastside pine forest type). No canopy cover restrictions apply.
CWHR size classes 3, 4, and 5 with canopy cover 40-50% (all allocations outside defense zones)	Mechanical treatments may only remove trees less than 6 inches dbh.
CWHR types 4M and 4D in old forest emphasis areas and California spotted owl HRCAs where the following conditions are met: ▪ amount of habitat is sufficient to meet home range core acreage requirement, and ▪ treatments beyond prescribed burning and removing material less than 12 inches are needed to meet fuels objectives	Mechanical treatments may: ▪ remove trees less than 20 inches dbh and ▪ reduce canopy cover provided by dominant and codominant trees by no more than 20%.
CWHR types 4M and 4D in threat zones where the following condition is met: ▪ amount of habitat is sufficient to meet HRCA acreage requirement	
CWHR types 3S, 3P, 4S, 4P, 5S, 5P in threat zones and general forest, and CWHR types 4M and 4D in general forest	

CWHR = California Wildlife Habitat Relationships system

Herger-Feinstein Quincy Library Group Forest Recovery Act Pilot Project

Under Alternative S1, the standards and guidelines in the SNFPA ROD apply to the HFQLG Forest Recovery Act pilot project with one exception. Instead of the SNFPA aquatic management strategy, the

Scientific Analysis Team (SAT) guidelines for managing riparian areas apply to all vegetation management activities in the pilot project area for the life of the pilot project.

Standards and Guidelines for Sensitive Species and Meadow Ecosystems

Willow Flycatcher

Under Alternative S1, grazing would be eliminated or significantly restricted in meadows where willow flycatchers have historically been detected. In addition, suitable habitat within a 5-mile radius of these meadows would be surveyed by the year 2006. Detection of willow flycatchers in other locations within active allotments would result in late-season grazing restrictions (i.e. after August 31). Late season grazing restrictions would also apply where required surveys have not been completed in the specified timeframe, until they are conducted and yield no detections.

Definitions of Willow Flycatcher Site Occupancy

The definitions (known, occupied, unoccupied) for willow flycatcher sites as defined in the SNFPA FEIS remain the same for this alternative. The SNFPA FEIS defined *known* willow flycatcher sites as meadows or riparian areas with documented willow flycatcher presence during the breeding season, specifically, either:

1. willow flycatcher observed between June 15 and August 1;

OR

2. willow flycatcher observed between June 1 - June 14, or August 2 - August 15, unless willow flycatcher was:
    - absent during surveys conducted between June 15 and July 15 in the same year,
    - absent during June 15 to July 15 surveys in multiple subsequent years, or
    - detected at a site that is clearly outside of known habitat requirements.

Yosemite Toad

Under Alternative S1, livestock (including pack stock and saddle stock) would be excluded from habitat occupied by Yosemite toads (i.e. standing water and saturated soils) during the breeding and rearing seasons. Where it is not practical to exclude livestock from the occupied portions of meadows, livestock would be excluded from the entire meadow. Surveys of suitable habitat within the species historic range would be completed by 2004. Livestock would be excluded from suitable habitat that has not been surveyed within the time allotted, until such work is completed.

Great Gray Owl

Alternative S1 requires that herbaceous vegetation in meadow areas of great gray owl PACs be maintained 12 inches high or greater and cover at least 90% of the meadow.

Species Associated with Old Forests

Alternative S1 includes standards and guidelines that require limited operating periods for all new resource management activities in the vicinity of nest sites for the California spotted owl and northern goshawk and furbearer den sites. Limited operating periods may apply to existing recreation and road and trail use where analysis of proposed projects or activities indicates that such activities are likely to disturb nest or den sites.

Meadow Ecosystems

For season-long grazing, Alternative S1 limits utilization of grass and grass-like plants in meadows in early-seral status to 30% (or minimum 6-inch stubble height). For meadows in late seral status, utilization is limited to 40% (or minimum 4-inch stubble height).

Adaptive Management, Monitoring Strategy, and Strategic Planning

Alternative S1 would include the concepts of adaptive management and monitoring as described in the SNFPA ROD and Appendix E of the SNFPA FEIS. The focus would be on testing "new and innovative management techniques" using formal adaptive management research projects or administrative studies done in conjunction with the Pacific Southwest Research Station or other scientific research institutions.

Under the auspices of adaptive management, an administrative study in the HFQLG Pilot Project Area would be initiated to examine the effects of management-caused changes in vegetation on spotted owl habitat and population dynamics.

A monitoring team would orchestrate regional data collection and work in close collaboration with the Pacific Southwest Research Station. A monitoring and evaluation report for the Sierra Nevada would be completed each year. Monitoring results would be evaluated each year in collaboration with appropriate federal and state agencies. When monitoring indicated a need to change resource management, this would be accomplished through forest plan amendments or revisions.

2.3.3. Alternative S2 - Proposed Action

Theme and Overall Management Approach

Under the proposed action (Alternative S2), Forest Service managers would use thinning, salvage, and prescribed and natural fires to make forests less susceptible to the effects of uncharacteristically severe wildfires, as well as invasive pests and diseases. Goals established in the SNFPA ROD for conservation of old forest ecosystems and associated species would be retained. However, this alternative also provides for other important elements of old forest ecosystems, including the objectives of reducing stand density and regenerating shade intolerant species.

Alternative S2 would adopt an integrated vegetation management strategy with the primary objective of protecting communities and modifying landscape-scale fire behavior to reduce the size and severity of wildfires. This alternative would provide for the removal of some medium-sized trees to increase the likelihood of accomplishing program goals with limited funding. Alternative S2 acknowledges the role that the Forest Service plays in providing a wood supply for local manufacturers and sustaining a part of the employment base in rural communities. This alternative would address the need to retain industry infrastructure by allowing wood by-products to be generated from fuels treatments and for dead and dying trees to be salvaged after wildfires. This active approach to vegetation and fuels management accepts the risks of temporarily changing some habitat for California spotted owls and other species to reduce the future risk of wildfire to habitat and human communities.

Alternative S2 would include the SNFPA ROD's network of land allocations, with some modification and clarification of the associated desired conditions. Alternative S2 would replace many of the standards and guidelines in the SNFPA ROD pertaining to old forest ecosystems, associated species conservation, and fire and fuels management. Alternative S2's replacement standards and guidelines would give greater flexibility to local managers to design projects to respond to local conditions, while meeting desired future conditions unique to each land allocation.

Pending completion of the forest plan amendments/revisions required by the HFQLG Forest Recovery Act, vegetation management activities on the Plumas and Lassen National Forests and the Sierraville Ranger District of the Tahoe National Forest would be guided by the direction of Alternative S2. Alternative S2 provides for implementation of the HFQLG Forest Recovery Act Pilot Project and employs the land allocations specified in the Act for the life of the pilot project. As in Alternative S1, vegetation management in riparian areas within the HFQLG Pilot Project Area would be handled under the SAT guidelines for the life of the pilot project.

Alternative S2 also includes standards and guidelines for managing grazing within habitat that is or has been occupied by the Yosemite toad and willow flycatcher. This management direction is designed to allow local managers to develop site-specific approaches to meet overall program goals for species conservation. Some flexibility is provided to allow managers to take advantage of unique opportunities that can only be identified at the project-level. This alternative would invoke limited operating periods for vegetation treatments in the vicinity of nest sites for California spotted owl and northern goshawk and near furbearer den sites.

Approach for Modifying Wildfire Behavior across Broad Landscapes

Section 2.3.1 “Common Elements of Alternatives S1 and S2” describes the approach under Alternative S2 for modifying fire behavior across broad landscapes. Alternative S2 explicitly recognizes two criteria that must be met for the strategy to be effective: the *pattern* of area treatments across the landscape must interrupt fire spread, and treatment *prescriptions* must be designed to significantly modify fire behavior within the treated area. Outside the HFQLG Pilot Project Area, 50% of initial fuels treatments under Alternative S2 would be located in the WUI. This percentage would apply at the bioregional scale until all treatments in the WUI have been completed.

Resource Considerations in Planning Treatment Areas Patterns

Alternative S2 would require a landscape-level design of fuels treatment patterns to be completed prior to project implementation. Treatment patterns would be developed using a collaborative, multi-stakeholder approach. Resource considerations to factor into the strategic placement of fuels treatments include the objectives of locating treatments to overlap areas of condition class two and three, high density stands, and pockets of insect and disease. Where consistent with fuels treatment objectives, small inclusions of stands classified as CWHR 5M, 5D and 6 would be avoided during project-level planning and implementation.

Under Alternative S2, managers would be directed to adjust the placement of treatment areas to avoid PACs to the greatest extent possible. PACs could be re-mapped during project planning to avoid intersections with treatment areas, provided that the re-mapped PACs contained habitat of equal quality, and included known nest sites and important roost sites. When it was necessary for treatment areas to intersect PACs, attempts would be made to avoid entering the PACs that contribute most to productivity of California spotted owls. Listed below are measures of PAC productivity that would be considered in choosing among alternative treatment patterns. The criteria are ranked in order of priority for avoidance.

1. PACs currently or historically supporting reproduction.
2. PACs currently occupied by pairs.
3. PACs currently occupied by territorial singles.
4. PACs currently unoccupied but historically occupied by pairs.
5. PACs currently unoccupied but historically occupied by territorial singles only.

Alternative S2 includes standards and guidelines that limit the acreage of PACs that could be treated throughout the Sierra Nevada national forests to no more than 5% of the total acreage of PACs in the bioregion each year. No more than 10% of the total acreage could be treated each decade.

Prescriptions for Area Treatments

Fuels treatment prescriptions would be designed to meet desired surface, ladder, and crown fuel conditions. Site-specific prescriptions would be designed to modify fire intensity and spread in treated areas. Managers would consider topographic position; slope steepness; predominant wind direction; and the amount and arrangement of surface, ladder, and crown fuels in developing fuels treatment prescriptions for each treated area. The first priority for fuels treatment would be to reduce surface and ladder fuels. Crown fuels would be modified to reduce the potential for spread of crown fire.

Fuels objectives would have first priority in the design of treatment areas. However, prescriptions for treatment areas would also address identified needs for increasing stand resistance to mortality from insects and disease. Thinning densely stocked stands could be used to reduce competition and improve tree vigor thereby reducing levels of insect- and disease-caused mortality.

Opportunities for Leveraging Appropriated Funds to Accomplish Fuels Treatments

Under Alternative S2, revenues from the sale of commercial forest products could be obtained from some fuels treatments. This would increase the likelihood of accomplishing the projected acres of treatment, an essential first step in achieving the desired reductions in acres burned. Where consistent with desired conditions, area treatments would be designed to be economically efficient and meet multiple objectives.

Timber sale contracts provide a mechanism for the efficient removal of commercially-valuable sawtimber. Contracts that have sufficient value offer capabilities for funding the accomplishment of additional resource management goals. Records from recent timber offerings indicate that sales with higher volumes per acre attract higher bids. Sales yielding an average 4.5 mbf/acre provide approximately $112/mbf, compared to only $38/mbf for 1.5 mbf/acre (Landram, pers comm).

The size of tree made available for harvest has a significant influence on sale volume per acre averages and thus, per unit bid values. Assuming typical heights, the board foot volume for a 12-inch dbh tree is 39, compared to 317 for a 20 inch tree and 710 for a 24 inch tree. Using these assumptions, 77 twelve-inch dbh trees would be needed to reach the minimum economically feasible sale volume (estimated at 3 mbf/acre). This compares to 9 trees of 20-inch dbh and 4 trees of 24-inch dbh. In summary, including only a few medium-sized trees can make a impact on the economic viability of a given project.

A number of options are available for deriving commercially-valuable wood products from fuels treatments. Where wood-fired electrical generation facilities exist and sufficient sawtimber value is present, small trees, e.g. biomass, can be removed. Bids in excess of required collections may also be made available for fuel reduction treatments within the sale area boundary. These treatments may include:

1) Shredding of ladder fuels, i.e. small trees, woody shrubs, and surface fuel,
2) Prescribed fire treatments following timber harvest, or
3) Fuel reduction treatments outside timber sale units (within the timber sale area boundary).

Alternatively, a stewardship contract package (a service contract, not a timber sale contract), that includes commercially-valuable sawtimber, may provide for cost-effective implementation of multiple fuels reduction projects within the contract area.

Ecosystem Restoration Following Catastrophic Disturbance Events

A catastrophic event occurs in a relatively short period of time and alters natural conditions beyond the range of conditions that are compatible with resource objectives for the affected area. After a catastrophic event, habitat once suitable for sensitive species may be rendered unsuitable for many years.

Under Alternative S2, restoration activities after catastrophic events are intended to gradually restore forest species composition and structure. Restoration activities include removal of excess dead wood (through salvage harvest, mechanical removal of non-merchantable material, prescribed fire, or a combination of these activities) and reforestation (through combinations of site preparation and planting, site preparation for natural regeneration, natural regeneration without site preparation, release, and animal damage control).

Restoration activities would be undertaken where forest succession is otherwise expected to create conditions outside the range of desired species composition and structure. For example, after a wildfire, a forest originally containing five tree species may develop over 30 to 50 years into a less complex manzanita- and whitethorn ceanothus-dominated shrubfield. This condition would eventually be succeeded by a sparse white fir and incense cedar tree forest with high fuel loads. Through active restoration, burned trees would be removed and the site would be reforested to reduce predicted fuel loads, regenerate all five tree species, and continue the successional path toward a moderately dense tree cover. The intent for restoring ecosystems following catastrophic drought, insect, disease, and wind events is similar. Action is urgent because delays limit options and decrease the likelihood of success.

Under Alternative S2, ecosystem restoration projects could be implemented in all land allocations. Managers would determine the need for ecosystem restoration projects following large, catastrophic disturbance events (wildfire, drought, insect and disease infestation, windstorm, and other unforeseen events). Objectives for these restoration projects would include limiting fuel loads over the long term, restoring habitat, and recovering economic value from dead and dying trees. In accomplishing restoration goals, these long-term objectives would be balanced with the short-term objective of reducing hazardous fuel loads.

Under Alternative S2, salvage harvest of dead and dying trees could be conducted to recover the economic value of this material and to support objectives for reducing hazardous fuels, improving forest health, re-introducing fire, and/or speeding recovery of old forest conditions. With some specific exceptions, salvage harvest would be allowed in all land allocations. In the WUI, treatments in PACs could remove salvage material to meet fuels objectives; outside of the WUI, salvage harvest would generally not be allowed in PACs that continued to be actively used.

Land Allocations

A set of desired conditions, management intent, and vegetation and fuels management objectives would apply to each land allocation under Alternative S2. These three elements would provide direction to land managers for designing and developing fuels and vegetation management projects that were consistent with the alternative's objectives for actively managing fire and fuels, old forest ecosystems, and California spotted owl habitat. In designing the strategic layout of treatments, managers would ensure that treatment patterns and prescriptions were consistent with the desired conditions, management intents, and objectives for the relevant land allocations, as well as the project-specific management standards and guidelines described in the next section. This assumption was explicitly incorporated in the analysis of environmental effects.

Land allocations for Alternative S2 are ranked so that management direction for a higher ranked land allocation overrides direction for a lower ranked land allocation when land allocations overlap. Land allocations for Alternative S2 are ranked as follows:

1. California spotted owl and northern goshawk PACs,
2. WUI defense zones,
3. California spotted owl HRCAs,
4. WUI threat zones,
5. old forest emphasis areas, and
6. general forest.

This ranking means that where an HRCA overlaps a WUI threat zone, managers would apply the desired conditions, management intent, and management objectives for HRCAs to the area of overlap.

Table 2.3.3a displays the desired conditions, management intent, and objectives for fuels and vegetation management activities within each land allocation.

Table 2.3.3a. Desired Conditions, Management Intent, and Management Objectives for Each Land Allocation under Alternative S2.

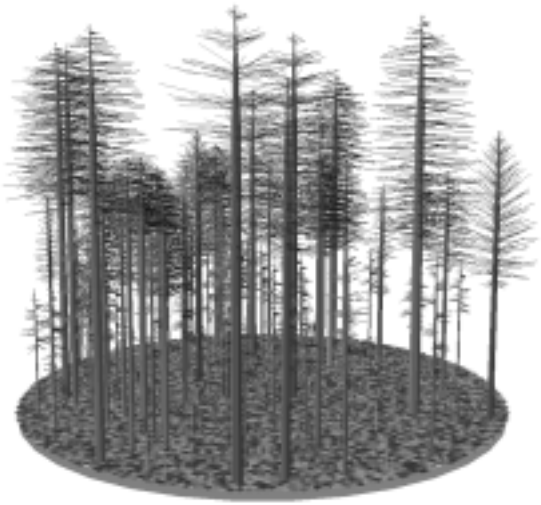
Land Allocation	Desired Conditions	Management Intent	Management Objectives
PACs	▪ At least two tree canopy layers are present. ▪ Dominant and co-dominant trees average at least 24 inches dbh. ▪ Area within PAC has 60- 70% canopy cover. ▪ Some very large snags are present (>45 inches dbh). ▪ Levels of snags and down woody material are higher than average.	▪ Maintain PACs so that they continue to provide habitat conditions that support successful reproduction of California spotted owls and northern goshawks.	▪ Avoid vegetation and fuels management activities within PACs to the greatest extent feasible. ▪ Reduce hazardous fuels in PACs in defense zones where conditions present unacceptable fire threat to communities. ▪ Where PACs cannot be avoided in the strategic placement of treatments, ensure effective treatment of surface, ladder, and crown fuels within treated areas.
WUI *Defense Zones*	▪ Stands are fairly open and dominated primarily by larger, fire tolerant trees. ▪ Surface and ladder fuel conditions are such that crown fire ignition is highly unlikely. ▪ The openness and discontinuity of crown fuels, both horizontally and vertically, result in very low probability of sustained crown fire.	▪ Prioritize fuels treatments in this land allocation. ▪ Protect communities from wildfire and prevent the loss of life and property. ▪ The highest density and intensity of treatments are located within the WUI.	▪ Create defensible space near communities, and provide a safe and effective area for supressing fire. ▪ Design economically efficient treatments to reduce hazardous fuels.

Land Allocation	Desired Conditions	Management Intent	Management Objectives
HRCAs	Within home ranges, HRCAs consist of large habitat blocks having: ▪ at least two tree canopy layers. ▪ at least 24 inches dbh in dominant and co-dominant trees. ▪ a number of very large (>45 inches dbh) old trees. ▪ at least 50-70% canopy cover. ▪ Higher than average levels of snags and down woody material.	▪ Treat fuels using a landscape approach for strategically placing area treatments to modify fire behavior. ▪ Retain existing suitable habitat, recognizing that habitat within treated areas may be modified to meet fuels objectives. ▪ Accelerate development of currently unsuitable habitat (in non-habitat inclusions such as plantations) into suitable condition. ▪ Arrange treatment patterns and design treatment prescriptions to avoid the highest quality habitat (CWHR types 5M, 5D, and 6) wherever possible.	▪ Establish and maintain a pattern of fuels treatments that is effective in modifying wildfire behavior. ▪ Design treatments in HRCAs to be economically efficent and to promote forest health where consistent with habitat objectives.
WUI *Threat Zones*	Under high fire weather conditions, wildland fire behavior in treated areas is characterized as follows: ▪ Flame lengths at the head of the fire are less than 4 feet. ▪ The rate of spread at the head of the fire is reduced to at least 50% of pre-treatment levels. ▪ Hazards to firefighters are reduced by keeping snag levels to 2 per acre. ▪ Production rates for fire line construction are doubled from pre-treatment levels.	▪ Priority area for fuels treatments. ▪ Fuels treatments in the threat zone provide a buffer between developed areas and wildlands. ▪ Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas. ▪ The highest density and intensity of treatments are located within the WUI.	▪ Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. ▪ Design economically efficient treatments to reduce hazardous fuels.

Land Allocation	Desired Conditions	Management Intent	Management Objectives
SSFCA	▪ Within known or estimated female fisher home ranges (4,500-8,000' elevation, mixed black oak/conifer) outside the WUI, a minimum of 50% of the forested area has ≥ 60% canopy cover. ▪ Where home range information is lacking, use HUC 6 watershed as the analysis area for this desired condition.	▪ Maintain high quality fisher habitat in the SSFCA to support successful reintroduction of fisher and a source population for recolonization of unoccupied, suitable habitat throughout the Sierra Nevada. ▪ Retain existing suitable habitat to the extent possible (CWHR 4D, 5D and 6), recognizing that habitat within treated areas may be modified to meet fuels objectives. ▪ Provide for heterogenous landscapes that may allow torching and small stand-replacing runs but will be resilient and retain-at a minimum-large tree elements to provide for future habitat and seed trees.	▪ When high quality fisher habitat in defense zones is treated, ensure effective treatment of surface, ladder, and crown fuels to create definsible space around communities. ▪ Within treated areas outside the defense zone, use irregular or clumpy treatments to maintain well dispersed or potential den sites. ▪ Moderate effects of fuels treatments on fisher wherever possible. Consider lighter treatments with a higher return interval to retain important habitat elements (e.g. retention of higher volume of down logs or shrub components) followed by treatments at 5 year intervals to reduce surface fuels as needed to achieve desired fuel conditions. ▪ Where high quality fisher habitat cannot be avoided during the strategic placement of treatments, consider scheduling the pace of treatments to spread impacts over a longer period of time.

Land Allocation	Desired Conditions	Management Intent	Management Objectives
Old Forest Emphasis Areas	▪ Forest structure and function resemble pre-settlement conditions, as indicated on the graphic, next page. ▪ High levels of horizontal and vertical diversity exist within 10,000 acre landscapes. ▪ Stands are composed of roughly even-aged plant groups, varying in size, species composition, and structure. Individual stands range from less than 0.5 to more than 5 acres in size. ▪ Tree sizes range from seedlings to very large diameter trees. ▪ Species composition varies by elevation, site productivity, and related environmental factors. ▪ Multi-tiered canopies, particularly in older forests, provide vertical heterogeneity. ▪ Dead trees, both standing and fallen, meet habitat needs of old-forest-associated species. ▪ Where possible, areas treated for fuels also provide for the successful establishment of early seral stage vegetation.	Maintain or develop old forest habitat in: ▪ Areas containing the best remaining large blocks or landscape concentrations of old forest. ▪ Areas that provide old forest functions (such as connectivity of habitat over a range of elevations to allow migration of wide-ranging old-forest-associated species). Establish and maintain a pattern of area treatments that is effective in: ▪ Modifying fire behavior. ▪ Culturing stand structure and composition to resemble pre-settlement conditions. ▪ Reducing susceptibility to insect/drought-related tree mortality. ▪ Focus management activities on the short-term goal of reducing the immediate threat of wildfire. Acknowledge the need for a longer-term strategy to restore both the structure and processes of these ecosystems.	▪ Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. ▪ Maintain and/or establish appropriate species composition and size classes. ▪ Reduce the risk of insect/drought-related mortality by managing stand density levels. ▪ Design economically efficient treatments to reduce hazardous fuels.
General Forest	▪ Same as above	▪ Actively manage general forest areas to maintain, and enhance a variety of vegetative conditions. ▪ Strategically place fuels treatments to modify wildfire behavior. ▪ Reduce hazardous fuels in key areas to lessen the threat of high severity fire.	▪ Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. ▪ Reduce the risk of insect/drought-related mortality by managing stand density levels. ▪ Design economically efficient treatments to reduce hazardous fuels.

Figure 2.3.3a. This graphic depicts desired conditions for old forest emphasis areas.



Standards and Guidelines for Area Treatments

The standards and guidelines in Alternative S2 are intended to (1) act as sideboards for local managers as they design projects to meet vegetation management objectives and respond to site-specific conditions, and (2) retain important components of habitat that are believed to be important to old-forest-associated species, including large trees, structural diversity and complexity, and moderate to high canopy cover. At the project level, these standards and guidelines are used along with the desired future condition, management intents and management objectives for the relevant land allocation to determine appropriate treatment prescriptions.

Prescribed burning is the only treatment option for PACs outside of WUIs. The extent of treatments in California spotted owl PACs is limited to no more than 5% of total PAC acreage per year and 10% of the PAC acreage per decade across the bioregion. Outside of PACs, managers can use either mechanical thinnings, salvage harvests, prescribed fire, or wildfire to conduct vegetation and fuels management. The vegetation management standards and guidelines apply only to thinning and, where specified, salvage harvest. All other activities that manipulate or remove vegetation (for example, land use, hazard tree removal, special use permits, etc.) are managed under existing forest plan direction and/or other authorities, as applicable.

Alternative S2 includes standards and guidelines for mechanical treatments that direct managers to design projects to retain larger trees as well as canopy cover. These standards and guidelines are applied across a treatment unit, based on aggregates of mature forest stands (CWHR classes 4M, 4D, 5M, 5D, and 6) within the unit. Alternative S2 does not require managers to retain minimum amounts of material following prescribed burning.

Tables 2.3.3b, c, and d display forest-wide standards and guidelines for mechanical thinning treatments under Alternative S2. Note that, with the exception of the defense zone, the standards and guidelines are the same for all land allocations. Within a given land allocation, management direction is distinguished according to groups of CWHR types and/or tree species (eastside pine).

A complete set of standards and guidelines for Alternative S2 is provided in Appendix A.

Table 2.3.3b. Alternative S2 Forest-Wide Standards and Guidelines for Mechanical Thinning in CWHR Types 4M, 4D, 5M, 5D, and 6 (Outside of Defense Zones and the Eastside Pine Type).

Management Intent	Standards and Guidelines
Maintain and develop old forest habitat conditions by emphasizing retention of larger trees.	Design projects to retain at least 40% of the existing basal area, generally consisting of the largest trees in each treatment unit.
Ensure recruitment of very large trees across the landscape by designing projects to retain larger trees. To permit operations, exceptions are allowed; however, projects will be designed to minimize operability impacts to trees ≥30 inches dbh wherever practicable.	Design projects to retain all live trees ≥30 inches dbh ; exceptions allowed for operability.
Allow project designers to balance the need to retain or develop understory structure as an important old forest habitat component with the need to reduce ladder and crown fuels.	Where possible, retain 5% or more of the total post-treatment canopy cover within the treatment unit in lower layers composed of trees 6-24 inches dbh.
Maintain high levels of canopy cover whenever it is possible to do so and still meet project objectives.	Where vegetative conditions permit, design projects to retain at least 50% canopy cover after treatment within the treatment unit, except where site-specific project objectives cannot be met (for example, achieving adequate height to live crown, providing sufficient spacing for equipment operation, minimizing re-entry, or realizing economically efficient treatments). Where 50% canopy cover retention cannot be met as described above, design projects to retain at least 40% canopy cover within the treatment unit.
Where canopy cover is at or near 40%, maintain canopy closure conditions suitable for dispersal and foraging for California spotted owls, while also allowing for effective fuels treatments.	Where pre-treatment canopy cover is at or near 40%, design projects to remove only surface and ladder fuels.
Avoid making significant changes in canopy density.	Design projects to avoid reducing pre-existing canopy cover by more than 30% within the treatment unit. Percent is measured in absolute terms (for example, do not reduce 80% canopy closure to less than 50%).

Table 2.3.3c. Alternative S2 Forest-Wide Standards and Guidelines for Mechanical Thinning in the Eastside Pine Type (CWHR Types 4M, 4D, 5M, 5D, and 6).

Intent	Standards and Guidelines
Maintain and develop old forest conditions in the eastside pine type by emphasizing retention of larger trees.	Design projects to retain at least 30% of the basal area in each treatment unit, generally consisting of the largest trees.
Ensure recruitment of very large trees across the landscape by designing projects to retain larger trees. To permit operations, exceptions are allowed; however, projects will be designed to minimize impacts to trees ≥30 inches.	Design projects to retain all live trees ≥30 inches dbh; exceptions allowed for operability.

Table 2.3.3d. Alternative S2 Forest-Wide Standards And Guidelines for Mechanical Thinning in All CWHR Types in Defense Zones and in CWHR Types 1, 2, and 3 Outside of Defense Zones.

Intent	Standards and Guidelines
Ensure recruitment of very large trees across the landscape by designing projects to retain larger trees. To permit operations, exceptionsaare allowed; however projects will be designed to minimize impacts to trees ≥30-inches.	Design projects to retain all live trees ≥30 inches dbh; exceptions allowed for operability.

Herger-Feinstein Quincy Library Group Forest Recovery Act Pilot Project

Under Alternative S2, the Lassen and Plumas National Forests and the Sierraville Ranger District of the Tahoe National Forest would implement the HFQLG Forest Recovery Act Pilot Project, consistent with the HFQLG Forest Recovery Act and Alternative 2 of the HFQLG EIS.

The HFQLG Forest Recovery Act pilot project is designed to test and demonstrate the effectiveness of certain fuels and vegetation management activities in meeting ecologic, economic, and fuel reduction objectives. Fuels and vegetation management activities include constructing a strategic system of defensible fuels profile zones (DFPZs), group selection, and individual tree selection. A management program for riparian areas is also included in the pilot project.

Alternative S2 includes the following direction for the HFQLG Forest Recovery Act Pilot Project activities[1], and non-pilot project activities, where specifically noted:

- Apply land allocations to the Lassen and Plumas National forests, and the Sierraville Ranger District of the Tahoe National Forest, which are described in the HFQLG Forest Recovery Act ROD and FEIS, with the exception that the land allocations for goshawk territories and marten and fisher habitat management areas do not apply. Apply the standards and guidelines found in Table 2.3.3e to the previously noted HFQLG Forest Recovery Act ROD and FEIS land allocations. Use Table 2.3.3e when a conflict raises between existing forest plan standards and guidelines and the management direction in Table 2.3.3e.
- Apply SNFPA standards and guidelines for management of goshawk protected activity centers (PACs), and forest carnivore den sites. Apply SNFPA standards and guidelines for management of goshawk PACs, with the caveat that DFPZs may be constructed within goshawk PACs, subject to the following limitations. In goshawk PACs, prohibit mechanical treatments within a 500-foot radius buffer around nest trees. Allow prescribed burning within the 500-foot radius buffer. Prior to burning, conduct hand treatments, including handline construction, tree pruning, and cutting of small trees (less than 6 inches dbh), within a 1-2 acre area surrounding known nest trees as needed to protect nest trees and trees in their immediate vicinity. The remaining area of the PAC may be mechanically treated to achieve the fuels reduction strategy of the DFPZ. Conduct mechanical treatments in no more than 5 percent per year and 10 percent per decade of the total acres in goshawk PACs within the 11 Sierra Nevada national forests.
- Apply SNFPA standards and guidelines for management of forest carnivore den sites, including marten and fisher.
- Implement the resource management activities mandated by the HFQLG Forest Recovery Act.

[1] "HFQLG Forest Recovery Act Pilot Project activities" are those activities set forth in the HFQLG Forest Recovery Act and Alternative 2 of the HFQLG EIS, such as DFPZ construction, group selection, individual tree selection, and riparian restoration.

- Apply SAT Guidelines, as set forth in the HFQLG EIS and ROD to vegetation management actions that are proposed for fuels reduction, timber management, area thinning, prescribed fire and salvage harvest within the Pilot Project Area for the life of the pilot project.
- Continue the long-term strategy for anadromous fish-producing watersheds for the Lassen National Forest, as set forth in Appendix I of the *Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement* (January 2001).

For forest management activities on the Lassen and Plumas National Forests and the Sierraville Ranger District of the Tahoe National Forest that are not part of the HFQLG Pilot Project or addressed above in Table 2.3.3e, follow the land allocations and standards and guidelines set forth in Alternative S2, as for other regions of the Sierra Nevada.

For purposes of effects analysis in this SEIS, it is assumed that after completion of the pilot project, vegetation and fuels management activities on the Plumas and Lassen National Forests and the Sierraville Ranger District of the Tahoe National Forest would be guided by the direction prescribed for Alternative S2 for the other Sierra Nevada national forests. The future forest plan amendment/revisions required by the HFQLG Act may, however, eventually modify that direction.

The standards and guidelines for fuels and vegetation management for the pilot project are shown in Table 2.3.3e. This table includes the direction for designing and implementing fuels and vegetation management activities within the various land allocations of the HFQLG Pilot Project Area for the life of the pilot project.

Table 2.3.3e. Alternative S2 Standards and Guidelines Applicable to the HFQLG Pilot Project Area.

HFQLG Land Allocation	Standards and Guidelines
Offbase and deferred areas	The following HFQLG resource management activities are prohibited: DFPZ construction, group selection, individual tree selection, all road building, all timber harvesting activities, and any riparian management that involves road construction or timber harvesting.
Late successional old growth (LSOG) rank 4 and 5	Group selection and individual tree selection are not allowed in LSOG 4 and 5 stands. DFPZ construction is allowed in LSOG 4 and 5 stands. Design DFPZs to avoid old forest stands (CWHR classes 5M, 5D, 6) within this allocation.
California spotted owl PACs	The following resource management activities - DFPZs, group selection, individual tree selection, and riparian restoration projects and other timber harvesting - are not allowed within spotted owl PACs.
California spotted owl habitat areas (SOHAs)	The following resource management activities - DFPZs, group selection, individual tree selection, and riparian restoration projects and other timber harvesting - are not allowed within spotted owl SOHAs.
National forest lands outside of the above allocations and available for vegetation and fuels management activities specified in the HFQLG Act	**DFPZs**
	Eastside pine types and all other CWHR 4M and 4D classes: ▪ Design projects to retain at least 30% of existing basal area, generally comprised of the largest trees. ▪ Design projects to retain all live trees ≥30 inches dbh; exceptions allowed for operability. Minimize impacts to ≥30-inch trees as much as practicable. ▪ For CHWR 4M and 4D classes that are not eastside pine types, retain, where available, 5% of total post-treatment canopy cover in lower layers comprised of trees 6 - 24-inches dbh. ▪ No other canopy cover requirements apply.

HFQLG Land Allocation	Standards and Guidelines
	CWHR 5M, 5D, and 6 classes except those referenced above: ▪ Design projects to retain a minimum of 40% canopy cover. ▪ Design projects to avoid reducing pre-treatment canopy cover by more than 30%. ▪ Design projects to retain at least 40% of existing basal area, generally comprised of the largest trees. ▪ Design projects to retain, where available, 5% of total post-treatment canopy cover in lower layers comprised of trees 6-24 inches dbh. ▪ Design projects to retain all live trees ≥30 inches dbh; exceptions allowed for operability. Minimize impacts to ≥30-inch trees as much as practicable.
	All other CWHR class stands: ▪ Retain all live trees ≥30 inches dbh, except to allow for operations. Minimize operations impacts to ≥30-inch trees as much as practicable.
	Group selection
	Design projects to retain all live trees ≥30 inches dbh, except allowed for operability. Minimize impacts to ≥30-inch trees as much as practicable.
	Area thinning (individual tree selection)
	All eastside pine types: ▪ Design projects to retain at least 30% of existing basal area, generally comprised of the largest trees ▪ Design projects to retain all live trees ≥30 inches dbh; exceptions allowed for operability. Minimize impacts to ≥30-inch trees as much as practicable. ▪ Canopy cover change is not restricted.
	CWHR classes 4D, 4M, 5D, 5M and 6 (except eastside pine type): ▪ Where vegetative conditions permit, design projects to retain ≥50% canopy cover after treatment averaged within the treatment unit, except where site-specific project objectives cannot be met. Where 50 percent canopy cover retention cannot be met as described above, design projects to retain a minimum of 40% canopy cover averaged within the treatment unit. ▪ Design projects to avoid reducing canopy cover by more than 30% from pre-treatment levels. ▪ Design projects to retain at least 40% of the existing basal area, generally comprised of the largest trees. ▪ Design projects to retain, where available, 5% of total post-treatment canopy cover in lower layers comprised of trees 6-24 inches dbh. ▪ Design projects to retain all live trees ≥30 inches dbh; exceptions allowed for operability. Minimize impacts to ≥30-inch trees as much as practicable.
	Down wood and snags
	▪ Determine retention levels of down woody material on an individual project basis. Within westside vegetation types, generally retain an average over the treatment unit of 10-15 tons of large down wood per acre. Within eastside vegetation types, generally retain an average of three large down logs per acre. Emphasize retention of wood that is in the earliest stages of decay. Consider the effects of follow-up prescribed fire in achieving desired retention levels of down wood. ▪ Determine snag retention levels on an individual project basis. Design projects to sustain across a landscape a generally continuous supply of snags and live decadent trees suitable for cavity nesting wildlife. Retain some mid and large diameter live trees that are currently in decline, have substantial wood defect, or have desirable characteristics (teakettle branches, large diameter broken top, large cavities in the bole) to serve as future replacement snags and to provide nesting structure. When determining snag retention levels, consider land allocation, desired condition, landscape position, and site conditions (such as

HFQLG Land Allocation	Standards and Guidelines
	riparian areas and ridge tops), avoiding uniform distribution across large areas. During project-level planning, consider the following guidelines for large-snag retention: In westside mixed conifer and ponderosa pine types, four of the largest snags per acre. ▪ In the red fir forest type, six of the largest snags per acre. ▪ In eastside pine and eastside mixed conifer forest types, three of the largest snags per acre. ▪ In westside hardwood ecosystems, four of the largest snags per acre (hardwood or conifer). ▪ Where standing live hardwood trees lack dead branches, six of the largest snags per acre to supplement wildlife needs for dead material. ▪ Use snags larger than 15 inches dbh to meet this guideline. Snags should be clumped and distributed irregularly across the treatment units. Consider leaving fewer snags strategically located in treatment areas within the WUI and DFPZs. While some snags will be lost due to hazard removal or use of prescribed fire, consider these potential losses during project planning to achieve desired snag retention levels.
	Spotted owl surveys
	▪ Prior to undertaking vegetation treatments in spotted owl habitat having unknown occupancy, conduct surveys in compliance with the Pacific Southwest Region survey direction and protocols, and designate PACs where appropriate according to survey results.

Standards and Guidelines for Sensitive Species and Meadow Ecosystems

Willow Flycatcher

Under Alternative S2, late-season grazing (after August 15) would be allowed only in meadows where willow flycatchers have recently been detected. Managers would have the option to extend the grazing period if a meadow-specific management plan has been developed to protect willow flycatcher habitat. When willow flycatchers are no longer detected at previously occupied sites, managers would assess meadow conditions and take restorative action where necessary.

Definitions of Willow Flycatcher Site Occupancy

This alternative requires maintaining a database that identifies and establishes the distinction between occupied and historically occupied sites. Moreover, these new standards and guidelines include criteria for determining when a site switches between these two categories (Robinson and Stefani 2003):

- **Occupied Willow Flycatcher Site.** A site where willow flycatcher(s) have been observed sometime during the breeding season since 1982. For a site to be designated as an occupied site, it must meet the following criteria:
    - Observation date(s) between 1982 and 2000:
        1. Willow flycatcher observed between 15 June and 1 August;

        OR

        2. Willow flycatcher observed between June 1 - June 14 or August 2 –August 15, unless the willow flycatcher was:

        - Absent during surveys conducted between June 15 and July 15 in the same year
        - Absent during June 15 –July 15 surveys in multiple subsequent years; or
        - Detected at a site that is clearly outside of known habitat requirements.
    - For inclusion as an occupied willow flycatcher site, willow flycatcher(s) must be identified by the *Fitz-bew* song or in-hand examination. Museum skins that are identified as willow flycatchers may also be used if the collection date falls within the range of dates listed above.
    - Nests and egg sets in museum collections infer site occupancy, regardless of collection month and day.
    - All sites where willow flycatchers were identified using these criteria are included in the dataset, unless the site is known to have undergone an extreme site conversion rendering it incapable of supporting willow flycatchers currently and in the future (e.g., wetland conversions or inundation by reservoir).
  - Observation date(s) in 2001 or later:
    - Willow flycatcher site occupancy will be determined based upon the classifications defined in the current standardized protocol.

- **Historically Occupied Willow Flycatcher Site.** A site where occupancy is only known from pre-1982 or one that has been surveyed for at least six years over a 10-year period and consistently found to contain no willow flycatchers during the breeding season. For a site to be designated as historically occupied, it must meet the following criteria:
  - Surveys across a minimum of six separate years during a 10-year period must have been performed (alternatively, surveys may be conducted annually for six years within a six- to 10-year period).
  - Surveys conducted since June 2000 must be in compliance with the current standardized willow flycatcher survey protocol guidelines.
  - If a historically occupied site is determined as occupied, the site is upgraded to occupied status until or unless the site meets the definition of historically occupied again.

  There are five sites in the existing database where survey documentation necessary to determine if the observation meets the criteria for an Occupied Site is missing or incomplete. These sites are assigned to a temporary category of Conditionally Occupied until either they receive one survey cycle or the missing information is discovered and documented, at which time they will either be found to be occupied or they will be dropped from the database. Once these sites are resolved, this category is no longer used.

- **Conditionally Occupied Willow Flycatcher Sites.** A site documented in the willow flycatcher database at the time of the Record of Decision that does not meet the criteria for an Occupied Site or a Historically Occupied Site. For these sites, either the month and day of detection are not known or the date of detection occurs outside after August 15.

Yosemite Toad

Under Alternative S2, livestock would be excluded from habitat occupied by Yosemite toads (standing water and saturated soils) during the breeding and rearing seasons. Where physical exclusion of livestock was impractical, livestock would be excluded from the entire meadow. Exclusion requirements could be waived if a site-specific management plan were developed and included a monitoring component.

Restrictions would apply only to commercial livestock and only in areas where surveys indicate occupancy.

Great Gray Owl

Under Alternative S2, meadows within great gray owl PACS would be managed to maintain herbaceous vegetation at a height commensurate with site capability and habitat needs of prey species.

Species Associated with Old Forests

Alternative S2 includes standards and guidelines that require limited operating periods for vegetative management activities in the vicinity of California spotted owl and northern goshawk nest sites and furbearer den sites.

Meadow Ecosystems

For season-long grazing under Alternative S2, utilization of grass and grass-like plants in meadows having early seral status would be limited to 30% (or minimum 6-inch stubble height). For meadows having late seral status, utilization would be limited to 40% (or minimum 4-inch stubble height). The above utilization standards could be modified if current practices are maintaining range in good to excellent condition.

Riparian Management Objectives

Alternative S2 does not repeat management direction found in other policy or regulation. The riparian conservation objectives of the SNFPA ROD were edited to remove redundant standards and guidelines before they were incorporated into the master set of standards and guidelines for this Alternative (Appendix A).

Adaptive Management and Monitoring Strategy

Adaptive management offers an approach to moving forward when decisions must be made in an environment of uncertainty. Kendall (2001) identifies four sources of uncertainty inherent in most resource management decisions:

- *Structural (or Ecological) Uncertainty* results from competing hypotheses about the nature of the dynamics of the populations, community, or landscape of interest.
- *Environmental Variation* occurs even when the system's structure is agreed upon and is manifested in residual variation (or noise) due to factors that are unaccounted for.
- *Partial Controllability* is when a management decision must be applied indirectly to a system, thereby creating variation in the impact.
- *Partial Observability* of natural systems occurs because assessments of landscape-level conditions and processes must always rely on sampling a subset of the target population, community, habitat, etc.

As suggested by several scientists, the Regional Forester invited Dr. William Kendall to visit the USFS Pacific Southwest Regional Office to discuss his experience in the application of the adaptive management approach to making decisions in the face of uncertainty. The Region hosted Dr. Kendall on September 18, 2003. Invitations were extended to the Interagency Team (IAT) as well. An exchange of questions and ideas helped formulate the adaptive management program adopted by the Region.

Clearly, all uncertainty cannot be eliminated. However, on-going management activities can be structured to "learn by doing" which is the essence of adaptive management (Walters and Holling 1990). The

concept extends beyond periodically monitoring ecological responses to ongoing management activities. Adaptive management has sometimes been equated to "experimental management" because policies and decisions are not viewed as final solutions but as hypotheses and opportunities for continued learning.

Several definitions of adaptive management can be found in the literature (Table 2.3.3f). As one author notes, these definitions "stem from vastly different institutional contexts, orientations toward problem-solving, and views of nature and science (Blann and Light, 1999).

Table 2.3.3f. Definitions of Adaptive Management.

Adaptive management is:	Source
"…the process of continually adjusting management in response to new information, knowledge, or technologies. Adaptive management recognizes that unknowns and uncertainty exist in the course of achieving any natural resource management goals. ….Adaptive management is ultimately dependent upon the ability of institutions to integrate new information into management decisions and approaches. New information gain and institutional response can be characterized in one of three ways. (1) **Trial and error learning** occurs when information is gained by chance. No structured information acquisition effort exists, but learning does occur. (2) **Passive adaptive management** occurs when new information is gathered in a structured manner, questions are pursued in a linear, sequential manner, and the information is incorporated into decision-making. (3) **Active adaptive management** occurs when new information is pursued through multiple hypothesis testing, with strong reliance on experimentation."	USFS, SNFPA, FEIS Appendix E
"a process which integrates environmental with economic and social understanding a the very beginning of the design process, in a sequence of steps during the design phase and after implementation…Adaptive management explicitly recognizes: ▪ The need for management decisions to examine economic, social and environmental values in an integrated way. ▪ The presence of many, diverse, stakeholders in environmental management issues; and ▪ The uncertainty inherent in environmental processes."	Holling 1978
"a process combining democratic principles, scientific analysis, education, and institutional learning to increase our understanding of ecosystem processes and the consequences of management interventions, and to improve the quality of data upon which decisions must be made."	Ecological Society of America 1996
"…an approach to natural resource policy that embodies a simple imperative: policies are experiments, learn from them. In order to live, we use resources of the world, but we do not understand nature well enough to know how to live harmoniously within environmental limits. Adaptive management takes that uncertainty seriously, treating human interventions in natural systems as experimental probes. Its practitioners take special care with information. First, they are explicit about what they expect, to that they can design methods and apparatus to make measurements. Second, they collect and analyze information so that expectations can be compared with actuality. Finally, they transform comparison into learning – they correct errors, improve their imperfect understanding, and change action and plans."	Lee 1993
"…a formal process entailing problem assessment, study design, implementation, monitoring, evaluation and feedback. Management activities are crafted as experiments to fill critical gaps in knowledge."	B.C. Ministry of Forests

Adaptive management is:	Source
"…a systematic process for continually improving management polices and practices by learning from the outcomes of operational programs. Its most effective form—"active" adaptive management—employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed. The key characteristics of adaptive management include a) acknowledgement of uncertainty about what policy is "best," b) thoughtful selection of policies or practices c) careful implementation of a plan, d) monitoring of the key response indicators, e) analysis of the outcome in consideration of the original objectives, and f) incorporation of the results into future decisions."	Nyberg and Taylor 1995
"…a concerted effort to integrate existing interdisciplinary experience and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies. …Most often, the knowledge gaps involve biophysical processes and relationships that have defied traditional methods of scientific investigation for various reasons, and most often it becomes apparent in the modeling process, that the quickest, most effective way to fill the gaps would be through focused, large-scale management experiments that directly reveal process impacts at the space-time scales where future management will actually occur."	Walters 1997
"…involves constructing a range of alternative response models (hypotheses) based on existing data, calculating the long-term value of knowing which is correct, and then weighing this long-term value against any short-term costs incurred in finding out which is correct. Active adaptive management involves deliberately perturbing the system to discriminate between alternative models (hypotheses)."	Taylor et.al. (1997)

Elements of adaptive resource management, as described by Kendall (2001) are as follows:

1. **A statement of objectives and constraints**

When completed, the objective(s) should be capable of being represented mathematically using a function and an accompanying set of constraints that balance the concerns of all stakeholders.

2. **A set of management options (hypotheses)**

Ideally, the number of management options should be limited, and all options considered should be meaningful.

3. **An understanding of the structure of the ecological system to be managed**

This is usually accomplished via the development of a set of models of system dynamics along with an associated measure of a model's relative credibility.

4. **A program for monitoring the results of management that informs the next management decision.**

This monitoring program must: a) provide information about the current state of the system and allow for an informed management decision based on predictions from the models under consideration; b) provide information about the new state of the system after the decision is implemented; and c) allow information collected during monitoring to influence the development of new models, as needed, especially when empirical predictive models are based on historical monitoring data.

To address the uncertainties associated with managing resources within complex ecosystems, adaptive management is explicitly incorporated into Alternative S2. Using this approach, the Forest Service will address a range of management issues that are deemed most crucial at this time. These issues are outlined and described below. Details of the scientific approach to be used to address each issue will be developed

during the first year after completion of the decision document for this SEIS. The underlying premise of adopting this adaptive management strategy is that careful experimentation through incremental active management will yield valuable information over time that will help to inform whether and how the management direction in Alternative S2 should be changed.

How the SEIS fits into the Adaptive Management Model

Completion of the multi-year planning effort for the Sierra Nevada bioregion represents the beginning of an adaptive management process. Management objectives (Element 1) are set forth conceptually in chapter 1 of the FEIS and further refined in chapter 1 of the SEIS. The quantitative representation of specific management objectives and constraints must be developed in the course of monitoring or during research design. Collectively, SNEP, the CASPO technical report, the FEIS, and the SEIS provide a synthesis of the "best available science" pertaining to the ecosystems of the Sierra Nevada and the associated physical and biological attributes. This extensive collection of research and scientific opinion, along with substantial public input and involvement provided the basis for developing an array of management options (Element 2), characterized in the NEPA process as "alternatives" and described in detail in chapter 2 of the FEIS and SEIS. Some models of system dynamics (Element 3) were developed (using SPECTRUM, etc) to project the effects of various management actions on the quality of habitat available for forest-dependent species and on wildland fire behavior. Although not an exhaustive treatment of potential hypotheses of ecosystem configuration and function, such efforts represent an initial attempt to characterize the dynamics of the ecological systems that will be subject to manipulation. Further conceptual and quantitative modeling will be necessary to set the context for experimentation and adaptive management. A description of the modeling process can be found in Appendix B of the final SEIS. The expected outcomes for each management option (i.e. alternative) are described in the "Environmental Consequences" sections of chapter 4 in the SEIS.

The record of decision (ROD) will identify the approach that the Regional Forester believes will best meet management objectives over the short planning horizon. The management direction contained in the ROD is intended to shift the current trajectory of forest conditions (function, structure, and composition) from conditions reflecting decades of fire suppression to conditions reflecting realignment with more typical fire regimes of the Sierra Nevada. Ultimately, the decision will attempt to strike a balance between the perceived benefit of active management and the risks associated with uncertainty about the response of natural systems to such actions. Outcomes of some management decisions are currently uncertain and this alternative incorporates adaptive management to structure the questions to be addressed and the way in which the necessary learning is to occur. To the extent that the management activities are designed to test the underlying hypotheses and assumptions, the decision serves as a starting point for continual refinement and/or validation. In other words, management direction is set forth with the expectation that it will be "adapted" to new levels of understanding over time. Thus, subsequent shifts in management direction will reflect what has been learned in the intervening years.

To date, there are few examples of scientifically credible large-scale multi-resource monitoring plans that have been developed, implemented, and validated (Noon et al. 1999). Large-scale monitoring efforts were developed and implemented for the Northwest Forest Plan (re: managing late-seral forests and aquatic-riparian ecosystems in the Pacific Northwest). These efforts are newly completed, and in some cases, still in progress. Currently, the ability to learn from these efforts is limited to reviewing their approaches and capitalizing on useful innovations. The U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) is a rare example of an ongoing, large-scale multi-resource monitoring effort. It strengths and weaknesses have been assessed in great detail (NRC 1994, 1995), and these assessments provide a valuable insights on how to proceed with meeting similar monitoring objectives. The principles have taken root in an array of resource management endeavors including those associated with CalFed, the Glen Canyon Dam, the B.C and Ontario Ministry of Forests and the Lincoln National Forest to name a few. Nevertheless, application of adaptive management to large, complex

resource management problems has relatively few proven results. The execution of such a program has many institutional and scientific challenges. Success will be most likely if the program is well organized and supported, and is implemented realistically through incremental steps.

The intellectual appeal of adaptive management is compelling and fundamentally simple. The idea of "learning while doing" is simple to understand and appears to offer a solution to management issues plagued by uncertainty. In fact, people have practiced what amounts to passive "adaptive management" or trial and error learning in resource management for many years in a variety of different problem contexts such as agriculture, fisheries, and forestry. Unfortunately, difficulties and disagreements tend to arise when discussions move past the conceptual stage. For instance, even among those well-versed in the theory of adaptive management, different answers will be found to the following questions:

- How many management options should be explored and which ones?
- What are the most important management questions to answer and what are the key uncertainties to be addressed?
- Does adaptive management require all activities to be conducted under the auspices of experimental design; must every project be designed as an experiment? If not, what criteria should be used to choose the number, location, and type of projects for more rigorous study?
- What degree of scientific rigor is needed to support meaningful "learning"?
- What outcomes signal a need for change in management direction? Who decides when the change occurs and what it should be?
- What constitutes a negative effect?
- Is a certain level/type of negative effect acceptable? Who decides what this is?

Limited resources, time and personnel dictate that these questions be addressed up-front in the design and commitment to an adaptive management approach. Fundamentally important is a process for identifying the objectives and questions, structuring current understanding of the system, and carefully designing the approach to collecting information. Underlying all of this is the need for a firm commitment to support the effort over the long term.

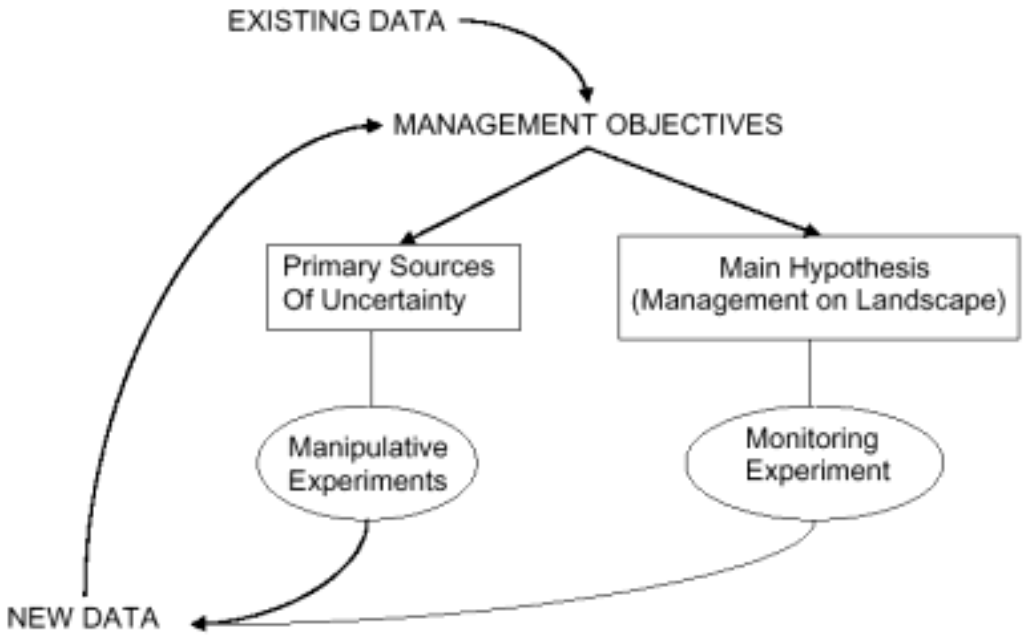
Linking Adaptive Management to the Sierra Nevada Forest Plan Decision

Appendix E of the FEIS provides a comprehensive discussion of the monitoring plan and research priorities to address areas of significant management uncertainty. The monitoring plan included in Appendix E is adopted by reference in Alternative S2. The following section brings forward a number of priority management questions from the aforementioned appendix, describes work already underway to answer them, and provide an outline for additional research. Where additional formal study is needed, opportunities for combining research with forest-level programs of work are identified.

These priority management questions represent the issues deemed most pressing at this time, as judged by the collective input from Forest Service professionals, other interested and involved local, State and Federal agencies, and the public comment. The number and selection of issues can fluctuate at any given time but the issues presented here appear to be the most crucial, particularly in the context of the proposed action. This is done with the expectation that the priorities may adjust over time. Such changes will need to be balanced with the ability and/or the wisdom to conclude ongoing monitoring or research efforts and to add new efforts.

The diagram below illustrates how uncertainty could be addressed through landscape-scale experiments and project level monitoring. Outcomes of experiments and monitoring are cycled back into the review, and possibly revision, of existing management objectives (policy) and direction (procedures).

Figure 2.3.3b. How uncertainty could be addressed through landscape-scale experiments and project level monitoring.



Monitoring and Research Initiatives

A comprehensive adaptive management program involves a strategic combination of different kinds of monitoring and research. All of the information collected for this purpose is assembled, reviewed, and integrated into a feedback loop that informs subsequent management decisions. The building blocks of this program are described below.

Implementation Monitoring

Implementation monitoring tracks whether and how management direction has been followed, including legal requirements and agency policies. The objective of implementation monitoring is to determine the degree to which application of standards and guidelines matches with management direction and intent. Tracking and reporting on implementation of management activities provides a record of accomplishment to the public and documents the extent and distribution of activities conducted by the forests. Managers can compare the results of implementation monitoring (observed actions) with management direction (expected actions) to assess performance. Managers can respond to results of implementation monitoring quickly, and make necessary changes in management through training and improvements in management approaches and prescriptions. Interagency evaluation of activity implementation at the project level can provide an opportunity for collaborative field review of activities authorized by the SEIS. Implementation monitoring is based on the standards and guidelines, as well as existing laws and regulations. Implementation monitoring data will provide information on the level of compliance (e.g., exceeded, met, not met, not capable of meeting) associated with a number of specific questions (FEIS, volume. 4, page. E-13).

Status and Change Monitoring

Status and change monitoring provides a description of the resources, landscape, sociocultural elements, and management activities of focus in this plan amendment. Status and change monitoring provides information on whether desired conditions are achieved as well as providing an early warning of unanticipated impacts from management or other activities. Status and change monitoring consists of (1) *condition monitoring*, which describes important biophysical and sociocultural conditions to gauge if desired conditions are being achieved, and (2) *affector monitoring*, which describes management actions plus biological and physical processes that have the potential to rapidly alter sociocultural processes.

In addition to describing the status and trends in conditions and affectors, this monitoring is intended to describe correlative relationships between affectors and conditions to assist in the identification of potential causal factors for observed changes. However, routine monitoring cannot elucidate cause and effect relationships (FEIS, volume. 4, page E-13).

Each year the Forest Service spends millions of dollars attempting to electronically capture information about planned and accomplished management activities. Some of this information ends up in budget databases as manager's account for the money that is received to complete projects. Other activity tracking information is captured in individual resource databases (i.e. fire, timber or water). Historically, much of this data exists in multiple databases where it has been difficult, if not impossible, to combine or synthesize.

A functional data collection storage and retrieval system is essential to the utility of the implementation monitoring strategy. Ideally, the system would include a spatial component to allow the use of GIS analysis to better understand the relationships among the different types of information being reported. In an effort to centralize activity reporting, the Regional Office has determined that the recently developed, FACTS database will be the main activity tracking system for projects. Beginning in fiscal year 2004, every forest in Region Five will begin using this system. A backlog of historic data will also be entered into the system to provide a baseline for evaluating management activity levels. For example, ten years of silvicultural activity data is being prepped for entry into the system.

Cause and Effect Monitoring and Research

Cause and effect monitoring and research seeks to gain a better understanding of how components, structures and processes respond to management activities, and how ecosystem components interrelate. Cause and effect monitoring and research consists of (1) management effectiveness questions to describe the effect of specific management actions on a desired condition, and (2) validation questions to determine whether assumptions made at any stage of planning or management are sound, particularly assumptions associated with management strategies, desired conditions, and the application of scientific knowledge.

Cause and effect monitoring and research involves testing hypotheses directly related to the effectiveness and underlying bases of management direction and actions. Thus, cause and effect monitoring and research requires careful consideration of the experimental design and analysis of the data to provide meaningful feedback to management. Cause and effect questions were formulated based on key areas of uncertainty and risk associated with management approaches, assumptions, and legal requirements related to the development and implementation of management direction. Cause and effect questions require companion implementation of status and change questions to provide a context for acting on information gained through cause and effect monitoring and research.

Standards and guidelines are a primary focus of cause and effect questions. Standards and guidelines have the force of a legal contract, and will be subject to scientific and legal challenge. But more importantly, the standards and guidelines reflect important assumptions about ecosystem behavior and response. Where there is uncertainty regarding the basis of these assumptions, cause and effect monitoring and research can be applied to reduce uncertainty and lower the risk of unintended negative effects. The level

of uncertainty will determine whether the cause and effect question addresses the effectiveness of the standard and guideline as written (uncertainty moderate) or validates the standard and guideline by testing a range of options to determine the most effective approach.

Given that standards and guidelines reflect important assumptions about ecosystem behavior and response, a focus of the adaptive management program will be reducing uncertainty in the weaker assumptions used as a basis for standards and guidelines. The adaptive management strategy is intended to provide greater assurance that key conservation objectives will be met by future management activities (FEIS, volume 4, pages E-13-E-14).

Key Areas of Uncertainty and Priority Management Questions

The Forest Service acknowledges that there are many questions that arise from the scientific uncertainty that inescapably surrounds the key management objectives identified in the SNFPA. The overarching adaptive management strategy detailed in Appendix E of the FEIS describes many of these questions and lays out a detailed outline of a comprehensive strategy. Not everything can be addressed at once. Thus, it is crucial to identify the questions that must and can be addressed first.

Below is a summary of these priorities as viewed today, based on public comments, scientific review, and the collective experiences of Forest Service managers and specialists. The articulation of these questions may evolve as implementation of the adaptive management strategy begins. However, at this time, there is general agreement that these questions capture the essence of the highest priority monitoring and research needs. As the adaptive management program evolves, new work may be identified and adjustments can and will be made, as needed, to respond to the information being collected.

The management questions presented here represent a first step and joining management intent with the feasibility of learning through carefully designed data collection and analysis. The complexity of these issues will require careful iteration of the definition of the precise questions, to be done between the management and policy makers and the technical experts/scientists who will design and execute the work to be done. This initial articulation of the questions is a first step. Over time these discussions will lead to a definition of each question in a manner that will satisfy management concerns and be feasible from a scientific point of view.

Strategies to address management questions are also in various degrees of development and the approaches described below are subject to additional refinement. Under Alternative S2, future investments in monitoring, research, and other efforts to promote learning will be targeted to address the programs and projects described in the following sections.

Wildland Fire

Uncertainties and Management Questions

It is uncertain to what degree high severity wildfires have increased over the past 10 to 25 years. It is uncertain as to the specific location, number, and character of fire and fuel treatments that will be placed in the landscape. It is also uncertain whether fuels treatments, as designed and implemented, will be effective in changing the behavior of fire and the resulting severity and extent of wildfires (FEIS, volume 4, page. E-33). Key management questions include:

1. Do fire and fuel treatments reduce the severity and total extent of wildfires? How does the theoretical Finney strategy (i.e. treating a portion of the landscape) perform when applied on a real landscape?
2. Are the fire and fuel strategies and treatments effective in achieving the desired fire behavior and restoration of the appropriate fire regime within the targeted vegetation types?

3. How effective are fuels treatments (combinations of prescribed burning and mechanical treatments) in realigning fire regimes with self-sustainable conditions of forest function and structure?

Based on the current assessment of information on wildland fire, in addition to a commitment to implementation monitoring, the following initial approach will be used to address the uncertainties surrounding wildland fire.

Efforts to reduce uncertainty about the effects of management activities on the California spotted owl and Pacific fisher will provide a template for testing the effectiveness of the fuels strategy adopted under Alternative S2. A complete set of treatments will be completed over a limited number of landscapes to evaluate effects to species of concerns. The same treated areas will allow testing of the effectiveness of various treatment patterns on fire behavior. To the extent that natural fires overlap with these treated areas, the performance of the fuels reduction strategy can be evaluated before it is applied across the entire bioregion.

Old Forest Habitat and Species

Uncertainties and Management Questions

Old Forest Habitat: The driving uncertainty associated with this issue is if and how the goals of reducing the threat of wildfires can be compatible with the simultaneous objectives of maintaining and restoring the quality and quantity of old forest ecosystems associated habitat values for species-at-risk (California spotted owl, northern goshawk, Pacific fisher, American marten, Sierra Nevada red fox, wolverine). It is uncertain whether unaltered wildfires would have a greater or lesser impact (spatial and temporal) on ecosystem integrity and habitat for these compared to the effects on habitat that will result from proposed fuels treatments. Uncertainty about the implementation and effectiveness of fuel treatments contributes to uncertainty about the level of risk these treatments pose to broader ecosystem goals. Concerns pertain to functional integrity (e.g., nutrient cycling, species diversity, hydrologic function), the quality and quantity of habitat for species-at-risk and the direct impacts to individuals (re: occupancy, reproductive success, or survivorship) (FEIS, volume. 4, page E-34).

California spotted owl: There is uncertainty about how California spotted owl viability in the Sierra Nevada will be affected by the habitat changes projected under Alternative S2. The key concerns stem from: 1) uncertainty about the factors driving current population trends, 2) uncertainty about habitat relationships and habitat quality, 3) uncertainty about the current distribution, amount, and quality of habitat, and 4) uncertainty about treatment effects (e.g., fuels and silvicultural treatments) on habitat and populations at multiple spatial scales (e.g., stand, home range, landscape, forest type). Information suggesting that owl populations are either stable or possibly declining dictates a conservative approach to management and highlights the need to continue to monitor population trends and examine factors that are postulated as potentially responsible (either currently or under future conditions) for population declines, should they be definitively observed and continue. Uncertainty about habitat relationships and habitat quality, or how habitat structure and composition affect survival and reproduction, make it difficult to assess current conditions and project how future scenarios may affect owl populations. Finally, the uncertainty related to the effects of treatments within protected activity centers, home ranges, and across the landscape on habitat and populations render it difficult to evaluate the efficacy of management and conservation efforts to provide for viability (FEIS, volume. 4, pages. E-49-E-50).

Pacific Fisher: Of primary concern regarding fisher viability is the effect of activities that are necessary to address the potential threat of catastrophic fire. Fuels treatments include the goals of reducing the canopy, basal area, and density of trees, snags and logs in selected patches that cumulatively occupy about 30% of the forest area in fire-prone elevations. At particular risk from both wildfire and prescribed fire are the large, rare and slow-to-renew elements of the forest (large diameter trees, snags and logs) that are important denning and resting sites for fishers. Moreover, the loss of canopy closure can increase the

depth of snow on the forest floor, which interferes with the movement of fishers (Krohn et al. 1995, 1997).

Salvage and hazard tree removal activities may also reduce numbers of large trees and down logs, potentially degrading habitat suitability (FEIS, volume 4, page. E-53). There is relatively little information about how fishers use their habitat and what the key elements of their habitat are. The extant fisher populations in the Sierra Nevada are at the southern most extent of their geographic range, thus they may actually be utilizing their habitat in ways that are different then what has been observed for fisher elsewhere (e.g. British Columbia, northern Great Lakes, northeastern United States, Canada).

There are many issues regarding old forest species that may deserve to be further investigated. Appendix E of the FEIS details a thorough list of issues that have been identified as important components of the SNFPA adaptive management program. Almost three years later, with some new information available (as identified in this SEIS) and renewed assessment of priorities, there are some questions that have been identified as necessary to pursue initially. Certainly, many other issues will deserve investigation at some future date but the following discussion identifies those issues that require immediate attention.

California Spotted Owl

The adaptive management strategy in the FEIS identified a series of monitoring and research issues that addressed California spotted owls. Given the uncertain status of this taxon and the potential risk of habitat alterations to California spotted owl survival and reproduction, certain monitoring and research activities are deemed immediate needs. Over the last three years, the understanding and appreciation of the vexing management questions related to California spotted owl habitat use has evolved. Questions for which managers need further information can now be more precisely defined. Three basic questions are currently defined as follows:

1. How do individuals and/or pairs of California spotted owls respond to reductions in canopy cover over some portion of their home range core area (HRCA)? Mechanical thinning of forests to reduce fuels hazards will address some ladder fuels and crown fuels in order to reduce the fuels condition class to acceptable conditions. This will reduce the number of trees by some amount (depending on pre-treatment stand conditions) with no trees greater than or equal to 30 inches removed and will reduce crown closure by as much as 30% and down to as low as 40% average within a stand.

   Null hypothesis: Changes in stand structure over some portion of the HRCA (perhaps up to 40% of a 1000 acre HRCA) by reductions of medium sized trees and canopy cover down to 40% has no effect on California spotted owl adult survivorship, reproduction, occupancy, or habitat use.

   Alternative hypothesis: Changes in stand structure over some portion of the HRCA (perhaps up to 40% of a 1000 acre HRCA) by reductions of medium sized trees and canopy cover down to 40% has a differential effect on California spotted owls resulting in lower adult survivorship, reproduction, occupancy, or habitat use.

2. How do individuals and/or pairs of California spotted owls respond to reductions in canopy cover over some portion of their protected activity center (PACs)? Mechanical thinning of forests to reduce fuels hazards may need to enter limited acres of California spotted owl PACs in order to result in effective fuels treatments for a given watershed. Such treatments will address some ladder fuels and crown fuels in order to reduce the fuels condition class to acceptable conditions within a treated area. This will reduce the number of trees by some amount (depending on pre-treatment stand conditions) with no trees greater than 30 inches removed and will reduce crown closure by as much as 30% and down to as low as 40% average within a stand.

Null hypothesis: Changes in stand structure over some portion of the PAC by reductions of medium sized trees and canopy cover down to 40% has no effect on California spotted owl adult survivorship, reproduction, occupancy, or habitat use.

Alternative hypothesis: Changes in stand structure over some portion of the PAC by reductions of medium sized trees and canopy cover down to 40% has a differential effect on California spotted owls resulting in lower adult survivorship, reproduction, occupancy, or habitat use.

3. How do interacting groups or populations of California spotted owls respond to strategically placed area treatments distributed across an entire landscape? This approach represents a fuels treatment strategy that is intended to reduce the intensity and rate of spread (ROS) of wildfires that are inevitably going to happen on Sierran landscapes. These treatments will be a series approximately 100 acre treated stands where surface, ground, ladder, and crown fuels are modified in a manner that is intended to change fire behavior on both the treated lands as well as the remainder of the landscape. Theoretically, treatment of ¼ to 1/3 of the landscape will accrue fuels management benefits to the entire landscape. Thus ¼ to 1/3 of the forest stands within a given landscape will have their structure modified. How will groups of owls in these landscapes (e.g. 10 pairs within a 50,000 acre watershed) respond to these changes in forest conditions?

   Null hypothesis: Changes in stand structure across a landscape resulting from implementation of a network of treatments (100 acre treatments over roughly 26% of a watershed) by reductions of medium sized trees and canopy cover down to 40% has no effect on California spotted owl adult survivorship, reproduction, occupancy, or habitat use.

   Alternative hypothesis: Changes in stand structure across a landscape resulting from implementation of a network of treatments (100-acre treatments over roughly 26% of a watershed) by reductions of medium sized trees and canopy cover down to 40% has a differential effect on California spotted owls resulting in lower adult survivorship, reproduction, occupancy, or habitat use.

Based on the current assessment of information on California spotted owls and the priority questions identified above, under Alternative S2, the following activities will be addressed as the initial program of work to reduce management uncertainties about this species.

A *paired-PAC study (treated/untreated) would be initiated* to test the response of the species to fuels treatment activities in the most sensitive habitat areas. In addition, *landscape-level studies would be designed* to evaluate the response of the species to different degrees of habitat modification at a larger scale. It is anticipated that the latter studies would also provide a template for assessing the effectiveness of the overall fuels strategy over time, depending on the extent to which natural wildfires overlap with treated landscapes. The aforementioned studies would be integrated into ongoing research projects, where possible. However, it is recognized that, depending on the actual study parameters, it might be necessary to redesign work already in process and/or rigorously structure project-level activities to ensure that the desired type and quality of information is obtained.

Pacific Fisher

The adaptive management strategy in the FEIS identified a series of monitoring and research issues that addressed fisher. Given the status of this taxon and the potential risk of habitat alterations to fisher survival and reproduction, certain monitoring and research activities are deemed immediate needs. Accordingly, four issues from the 2001 adaptive management strategy are brought forward here.

1. What is the status and change of the geographic distribution, abundance, reproductive success, and survivorship of the fisher population?

2. What is the near-term effect of the timing, extent, and type of fire and fuel treatments on site occupancy by fisher?
3. What are the habitat relationships of the fisher at the stand, home range, and landscape scales, particularly in relation to den sites? Do existing data on habitat relationships accurately represent habitat of fishers?
4. What are the reproduction and mortality rates of fishers and what environmental features are potentially influential?

Based on the current assessment of information on fisher, under Alternative S2, the following activities will be addressed as the initial program of work to reduce management uncertainties about this species.

The regionwide status and change monitoring efforts for fisher would be sustained. This regional status and trend monitoring described in the adaptive management strategy of the SNFPA FEIS has been implemented during the past 2 field seasons (FY 02 and 03). The first complete sample of the fisher population monitoring program will be completed during mid-November 2003. The ongoing monitoring program is indispensable because it provides the best information on the most important barometer of fisher population health in the Sierra: its distribution. As the fisher distribution increases and is restored to its former range, it will be easier to consider a variety of forest management options. The results of the last 2 years of monitoring indicate that fishers are well distributed on the Sequoia and Sierra National Forests. In fact, comparing the recent distribution of detections on Sierra NF to those from about 6 years ago one could be tempted to conclude that the number of sites with detections is increasing. Should the population expand northward, continued monitoring will allow documentation of the expansion of the species' range into the Stanislaus National Forest and northward. This program is essential to updating the existing state of knowledge regarding the fisher's distribution and, as a result, determining whether management actions are either fostering the expansion of fishers in the Sierra Nevada, or at least not reducing the area of the occupied range. This status and change monitoring program will be continued in 2005 and beyond, until it can be determined that the fisher has recolonized suitable habitat within its historical range.

Analysis and publication of specific active research efforts that support adaptive management would be supported. A number of ongoing research efforts will result in products that can help managers evaluate the effects of vegetation management on the habitat of fishers. These include models that have been developed from field data and that can be used to estimate fisher habitat value at a number of spatial scales. These models can be used to evaluate how changes in vegetation structure, at the plot and the landscape pixel scale, affect the predicted suitability. Thus, they can be used to evaluate changes that occur on the ground or can be used to evaluate simulated changes in stands or landscapes. These tools will be valuable in addressing the effect of specific fuels treatments on habitat value as well as evaluating the cumulative effects (in space and time) of vegetation treatments at the level of the watershed to the level of the entire range of the fisher in the Sierra Nevada. Properly applied, these models will be invaluable aids to the analysis required in Biological Evaluations and for the revision of Land Management Plans.

The papers that require additional support to speed their completion include:

Campbell, L. A. In prep. Habitat associations of carnivores in the central and southern Sierra Nevada. Ph.D. dissertation, University of California, Davis.

Mazzoni, A.K., K.L. Purcell, B.B. Boroski, and D.E. Grubbs. In prep. Resting habitat of fishers (Martes pennanti) in the southern Sierra Nevada. Intended outlet: Journal of Wildlife Management.

Truex, R. L. In prep. Landscape habitat suitability for fishers (*Martes pennanti*) in the southern Sierra Nevada of California. Ph.D. dissertation, University of California, Berkeley.

Truex, R. L., W. J. Zielinski, and F. V. Schlexer. In prep. Short-term effects of fire and fire surrogate treatments on fisher habitat in the Sierra Nevada. Intended outlet: Wildlife Society Bulletin.

Zielinski, W. J., R. L. Truex, J. R. Dunk, and T. Gaman. In prep. Using routinely-collected forest inventory data to estimate and monitor regional changes in the suitability of resting habitat for fishers (Martes pennanti). Intended outlet: Journal of Wildlife Management.

Zielinski, W. J., R. L. Truex, G. Schmidt, R. Schlexer and R. H. Barrett. In prep. Foraging habitat selection by fishers in California. Intended outlet: Journal of Wildlife Management.

The final year of a three-year study of fisher in the Kings River area would be completed (3rd year of 3-year field study through UC Berkeley). In 2004 data will be collected from this population that will be used to estimate population density, survival, and the proportion of females reproducing over the period of 2001 through 2004. Preliminary results on reproduction (based on a limited sample) show that 20 to 83% of captured females had likely reproduced in a given year, with an overall average of 48% of the 29 females captured since 1999 showing signs of having reproduced in the winter/spring prior to capture.

The feasibility of conducting cause and effect monitoring and vital signs research for the fisher would be investigated. The effects of Alternative S2 on fisher habitat are largely unknown, and there is an urgent need to understand the effects of the proposed fuels treatments on fishers and habitat elements important to them. In particular, there is a lack of understanding about the direct effects on the behavior of fishers and on the habitat choices they make when confronted with landscapes that have been modified to reduce the severity of threat to fire. This can only be determined with experiments that involve the animals themselves. Unfortunately, the fisher occurs at naturally low densities and the treatments may affect only a portion of their home range each year. Thus, study areas must be very large to achieve a sufficient sample of animals and the treatments must be applied in a manner regulated by the experimenter. These characteristics suggest that it may not be possible, within realistic budgets, to conduct an experiment that will be able to reject the hypothesis that the treatments have no effects on fishers. The feasibility of this type of experiment must be evaluated. This is not a trival exercise and it will require the time of research scientists and statisticians to evaluate (perhaps via simulation) various study designs. Until this exercise is completed, it is not possible for scientists to recommend the type of experiment that will be successful at determining whether the treatments (the ‘cause’) do not change the probability of fishers persisting and reproducing in treated areas (the ‘effect’).

It is also important to study fisher vital rates (survival and reproduction) in the Sierra Nevada and how they may vary in landscapes with different characterisitics and different levels of fuels treatments. This subject, too, requires a feasibility analysis to determine if sufficient data can be collected to determine whether the treatments have negative, positive or neutral effects on survival and reproductive rates. The feasibility analysis will result in conclusions about the cost and value of conducting studies of vital rates, especially in conjunction with the other monitoring and adaptive management actions that may be implemented on behalf of fishers. If the feasibility studies determine that cause and effect experimentation and vital signs research would have a high probability of success, implementation of a pilot project would be a logical next step.

The Forest Service would actively consult with the California Department of Fish and Game and other partners to explore the feasibility of reintroducing the fisher to the northern Sierra Nevada. Analytical support for this endeavor would be provided by PSW, using existing FIA-based and landscape suitability models to identify potential areas for reintroduction. Comprehensive habitat analysis would precede reintroductions to assure that the animals had a reasonable chance of success.

Aquatic, Riparian, and Meadow Ecosystems

Uncertainties and Management Questions

Yosemite toad: The major area of uncertainty regarding Yosemite toads revolves around habitat conditions and the relationship of disturbance (both natural and human-induced) to meadows to population response. Overall viability of the mountain meadow ecosystems is contingent on a variety of physical and biological factors that are not completely understood. Management activities in mountain meadows have an influence on these factors and thus, can impact populations of this species. One of the particular management issues related to this concern is the effect of proposed livestock grazing standards on habitat conditions. The proposed standards change the timing and intensity of meadow use but these approaches are untested with regard to the population and habitat needs of the Yosemite toad. While eggs and tadpoles are confined to small breeding areas, metamorphs are found throughout meadows, and are thus likely to be more vulnerable to direct mortality from livestock than are eggs and tadpoles. More thorough and targeted scientific information is needed to determine if and how livestock could be compatible with persistence of self-sustaining populations of Yosemite toads.

While research on environmental toxin effects on this species has not yet been conducted, closely related frog and toad species in other regions have shown sensitivity to numerous pesticides, herbicides, and fertilizers (Berrill et. al. 1997, LeBlanc and Bain 1997). Because these chemicals are thought to disrupt endocrine systems in amphibians at low concentrations, application of pesticides and herbicides are considered to be a risk factor for the Yosemite toad. Thus, the extent of use and the effects of increased herbicide use for noxious weed control and silvicultural applications and the interaction of these two uses are a key uncertainty.

There are also several information gaps that create general areas of uncertainty common to this amphibian species. Basic life history (e.g., longevity, fecundity), population dynamics, and metapopulation characteristics are poorly known. Habitat associations are better understood, but research is needed on seasonal and life stage variations in habitat requirements. While there is fairly good qualitative information on the historic and current distributions of the species, a quantitative range-wide analysis of its status is needed (FEIS, volume 4, pages E-91-E-92). This work has been initiated by a regionwide status and trend monitoring program and results are beginning to fill in information gaps.

Again, a subset of the monitoring and research questions originally identified in Appendix E of the FEIS are brought forward here. These are questions that are considered the most crucial issues that need to be addressed, particularly in light of the changes proposed in Alternative S2. These questions include:

1. What are the direct and indirect effects of various livestock grazing practices on Yosemite toads and their habitat?
2. What are the habitat requirements (including biological factors such as introduced fish) of Yosemite toads at multiple scales (local population and subwatershed/meadow complex) and what is needed to maintain or restore the population and genetic structure of these species?

Based on the current assessment of information on the Yosemite toad, under Alternative S2, the following activities would be addressed as the initial program of work to reduce management uncertainties about this species.

Six allotments from the Stanislaus and Sierra National Forest would be selected for an adaptive management study. Stanislaus National Forest allotments may include Long Valley/Eagle Meadow, Herring Creek, Highland Lakes, and Cooper. Sierra National Forest allotments may include Blasingame and Dinkey. The actual allotments selected would be determined in collaboration with forest range specialists, biologists, managers, researchers and the affected permittees. On each allotment, one or more meadows would be selected as controls (total exclusion of grazing) and the remaining meadows would be grazed according to applicable utilization standards. There would be no limited operating period invoked

or exclusion of use on the grazed meadows. Attributes to be studies would include distribution, abundance, and demographic characteristics (e.g. reproductive and survival rates); in-stream, pond and meadow characteristics (e.g. measures of hydrologic regimes, water depth, fine and course sediments, water temperature, and meadow vegetation composition and microclimate); and various livestock grazing practices (e.g. grazing utilization, method, duration, and season).

Site-specific management plans would be developed for some allotments where grazing occurs in occupied Yosemite toad habitat. These management plans would be developed by an interdisciplinary team, and include a biological evaluation and a monitoring plan.

Willow flycatcher: Current willow flycatcher populations are estimated to range from 300 to 400 individuals with 120 to 150 individuals on National Forest System lands in the Sierra Nevada (Green et al. 2003). There is uncertainty as to whether all extant populations are known. It is estimated that only approximately 60-70 percent of currently occupied willow flycatcher sites have been identified. Thus, there is some risk of impact to willow flycatchers from management activities because managers are unaware of the species' presence. Furthermore, restoration of suitable habitat to increase the population requires a more thorough understanding of the limiting factors that influence population performance. Influences to and condition of overall montane meadow ecosystems are poorly understood. Impacts from livestock to vegetation, hydrology, and stream banks (and thus indirectly to willow flycatchers) are among the management activities that create uncertainty. It is unclear whether grazing and recreation standards and guidelines will reduce the threat of cowbird parasitism. Potential grazing impacts in occupied willow flycatcher habitat after the breeding season may reduce habitat suitability in subsequent years. Finally, uncertainty remains as to whether potential grazing impacts outside of occupied habitat will allow flycatchers to expand into new areas (FEIS, volume 4, page E-94).

Again, a subset of the monitoring and research questions originally identified in Appendix E of the FEIS are brought forward here. These are questions that are considered the most crucial issues that need to be addressed, particularly in light of the changes proposed in Alternative S2. These questions include:

1. What are the habitat characteristics of the willow flycatcher at the local, territory, and landscape scale and how do they relate to abundance and reproductive success?
2. What are the direct and indirect effects of various livestock grazing practices on willow flycatchers and their habitat?

Based on the current assessment of information on the willow flycatcher, under Alternative S2, the following activities would be addressed as the initial program of work to reduce management uncertainties about this species.

The Regional Office would develop a conservation strategy for willow flycatchers in the Sierra Nevada. This conservation strategy would be informed by information contained in the recently completed Willow Flycatcher Conservation Assessment (Green et al. 2003) and include specific management recommendations for such issues as meadow condition, monitoring, nest predation, habitat restoration, and cowbird paratism. The conservation strategy would be an interagency product, incorporating input from the state of California as well as the U.S. Fish and Wildlife Service. Once completed, a conservation agreement would be utilized to apply the conservation strategy throughout the range of the willow flycatcher in the Sierra Nevada.

Site-specific management plans would be developed for some allotments where grazing occurs in occupied willow flycatcher habitat. These management plans will be developed by an interdisciplinary team, and include a biological evaluation and a monitoring plan.

Meadow condition: It is uncertain whether the combination of proposed management activities will be effective in moving meadows toward desired conditions. It also uncertain whether livestock grazing policies result in improved meadow condition and whether other policies would be more effective (FEIS,

volume 4, page E-83). The Science Consistency Review for this planning effort noted that meadows are extremely complex ecosystems consisting of numerous interacting variables. Further study and the development of additional knowledge about the complex workings of these systems is warranted.

Given the ecological value of montane meadows to a suite of species a more holistic approach to examination of meadow health is warranted. In the 2002 FEIS Adaptive Management strategy the key question identified was:

- What livestock grazing standards are most effective in maintaining and restoring physical, chemical, and biological conditions in stream, riparian, and meadow ecosystems?

Based on the current assessment of information on meadow condition, under Alternative S2, the following activities would be addressed as the initial program of work to reduce management uncertainties.

The regionwide program of status and change monitoring for meadows will be reviewed and evaluated to ensure inclusion of the appropriate set of elements. Given the range of issues surrounding the ecological condition of montane meadows, the general issue should be addressed as well, or in combination with more specific questions regarding effects of grazing on montane meadows. There is a need to bolster understanding about how meadows function, how hydrologic regimes influence primary productivity, and how fluctuations in weather patterns factor into these issues. Sierra meadows are extremely important to birds, and avian monitoring can provide feedback from a whole suite of organisms within a system making birds a cost-effective, practical alternative for eliciting the necessary feedback of the effects of meadow management. Therefore, a rangewide, multi-taxa monitoring plan for mountain meadows is an important step towards addressing the health of montane meadows. Other aspects of meadow ecology such as hydrological regimes, sedimentation, and vegetation succession should be incorporated into the overall design of montane meadow monitoring.

Ongoing Monitoring and Research Relevant to this Adaptive Management Program

There are a number on ongoing monitoring and research activities that touch on part of the anticipated needs described in the SNFPA adaptive management program. Some of this work is being executed by the Pacific Southwest Research Station of the Forest Service, some is being done or funded by the Regional Office, and some is being done by various academic and other research institutions. A successful adaptive management program of the scope and complexity as that contemplated here will require contributions from many different sources. Coordination, collaboration, and effective communication will need to work if the expectations of this program are to be realized.

Below, is a summary of some of the key ongoing activities that will make meaningful contributions to the overall goals of adaptive management in the Sierra Nevada. Further collaboration and coordination will need to be executed in the subsequent execution of monitoring and research done in the Sierra. The design, objectives and implementation of the following projects may be reviewed and adjusted to better address the key management questions identified in the previous section.

Owl Demographic Studies

There are four ongoing California spotted owl demography studies within the Sierra Nevada bioregion:

- Lassen national forest, 1300 km2 study area (1990-present)
- Eldorado National Forest, 355 km2 study area (1986-present)
- Sierra National Forest, 417 km2 and a 267 km2 study areas (1990 and 1994-present)
- Sequoia and Kings Canyon National Parks, 337 km2 (1990-present)

Another demographic study was conducted on the San Bernadino National Forest from 1987-1998.

Collaborators involved in this long term work include the Dr. Rocky Gutierrez and Mark Seamans from the University of Minnesota (El Dorado study area) , Dr.s Barry Noon and Jennifer Blakesley from Colorado State University (Lassen study area), and researchers at the Pacific Southwest Research Station of the Forest Service (Sierra and Sequoia study areas).

Study objectives vary slightly but generally include all or most of the following:

1. Estimate densities of spotted owls and occupancy status of owl territories in the designated study area;
2. Estimate demographic parameters (survival rates by age and sex, nesting, nest success, productivity and fecundity rates, the rate of change of the population size, and the population structure;
3. Assess the site fidelity of individual owls;
4. Estimate the number of missing and replaced owls;
5. Quantify the distribution of habitats within the study areas (Sierra/Sequoia studies only);
6. Characterize the diets of owls from regurgitated pellets and compare diets of breeding and nonbreeding pairs during the breeding period (Sierra/Sequoia studies only).

The data from the five demographic studies were analyzed in a meta-analysis conducted by spotted owl biologists in conjunction with scientists in expertise in population biology, statistics, and data analysis (Franklin et. al. 2003). The data from the demographic studies comprise the only empirical information on California spotted owl population trends, survival, and reproduction over the past 7-12 years. As recommended in the meta-analysis report, the demographic studies provide a valuable opportunity to conduct adaptive management experiments because of the rich set of baseline data that exists. The authors of the report provide the following recommendations:

a. Develop comprehensive, accurate vegetation maps on the demographic study areas in order to evaluate the influence of landscape habitat characteristics on variation and trends in demographic parameters;
b. Coordinate the existing demographic studies with forest management activities to develop quasi-experiments on the effects of these activities on demographic parameters; and
c. Design landscape-scale experiments to assess the effects of silvicultural treatments designed to reduce fire risks and the owl’s response to controlled logging and silvicultural treatments.

Currently, the demographic studies do not directly address any of the priority management questions. However, they do provide an unparalleled baseline from which to begin research on some of the causal aspects of California spotted owl behavior. A study of the effects of habitat change on demographic parameters would be consistent with the priority management questions identified above. Because the Lassen study area is part of the HFQLG pilot project area and the Sierra National Forest study area overlaps with the King River administrative study (see below), the Eldorado National Forest study area is a prime candidate for studying the effects of management activities on the species. The baseline population and reproductive history are well-documented and the study area is of a size that will allow the fuels strategy to be tested at a fireshed scale. Depending on required sample sizes and replicate sites required to reach statistically valid conclusions, it may be possible to address some of the priority management questions with one or two carefully designed experiments conducted inside the pre-existing study area.

Kings River Project

The Kings River Project was developed from the consolidation of the Kings River Administrative Study and ongoing PSW research studies. The project area is large enough (approximately 131,500 acres within the Dinkey Creek and Big Creek watersheds of the Kings River drainage on the Sierra National Forest) to allow replication of experiments and represents the heterogeneity of southern Sierra ecosystem types. Research study areas range in size from very localized small plots to small watersheds and landscapes depending on the species or process being studied. Small mammal plots are only five acres in size, forest bird study plots are 99 acres, experimental watersheds are 120-560 acres, and owl pair study areas will be 1,000 acres.

The overall purpose of the Kings River Project is to evaluate the response of forest ecosystems to a management strategy consisting of a specific uneven-aged silviculture and prescribed fire program. The nature of this program has been defined by the management team from the Sierra National Forest in consultation with scientists at PSW. There are several study components: the uneven-aged management strategy, the Kings River Experimental Watershed, California spotted owl, fisher, forest birds, and air quality. Some of these components are ongoing, long-term research, while others are newer (such as air quality). In addition to PSW research and case studies, there will be forest monitoring of effects.

The purpose of the uneven-aged management strategy is to determine if the planned vegetation treatments result in a historic forest structure and composition thought to dominate the western Sierra Nevada before the advent of European influences. The forested portion of the Kings River Project has been divided into 80 management units. Over approximately the first 35 years, all of the management units would potentially have projects planned to change the vegetation by applying the uneven-aged management strategy and by periodically underburning.

Specific questions for 25 and 50 years after the initial application of the uneven-aged management strategy and the initial underburning between treated and untreated management units include:

a. What is the difference in tree age, species and size distribution?

b. What is the difference in canopy cover of medium (20-34.9” dbh) and large trees (>35” dbh)?

c. What is the change in total basal area?

d. What are practical considerations, limitations and costs of implementing the Uneven-aged Management Strategy?

For the aquatic systems, the Kings River Experimental Watershed (KREW) is a study within the Kings River Project led by research scientists at PSW. The intention of the KREW is to be as holistic and integrated as possible with a focus on headwater stream ecosystems and their associated watersheds. The KREW study is designed as a long-term study with 15-year minimum period of study that started in the year 2000. The main goals of KREW are to quantify the existing condition and variability in the characteristics of headwater stream ecosystems and their associated watersheds. Selected measurements for evaluation include nutrient budgets, sediment budgets, stream food web and/or energy budget, geological and geomorphic processes, and vegetation and fuel loading characteristics.

The Kings River experimental watershed study addresses:

a. What is the effect of fire and fuels reduction treatments (i.e. thinning of trees) on the riparian and stream physical, chemical, and biological conditions?

b. Does the use of prescribed fire increase or decrease the rate of erosion (long term versus short term) and affect soil health and productivity?

c. How adequate and effective are current stream buffers at protecting aquatic ecosystems?

Several PSW wildlife studies are also ongoing or planned to address the following questions:

a. What are the short-term responses of fishers, owls, and other sensitive species to the treatments?

b. Do sensitive species populations increase, decrease or remain stable in response to treatments and in comparison to no treatments?

c. What are the trends in the distribution and abundance of fishers, owls and other sensitive species after 10, 20, and 50 years?

Six owl territories (four active and two inactive) have been selected for treatment in the first five years of the project. More territories will be selected for study, as the project moves forward with additional treatments.

Plumas/Lassen Case Study

The impetus for this work comes from the Records of Decision (RODs) for both the Sierra Nevada Forest Plan Amendment (SNFPA) and the Herger-Feinstein Quincy Library Group (HFQLG) Forest Recovery Act Pilot Project. The HFQLG pilot project was initiated under the HFQLG Forest Recovery Act to demonstrate how a strategy of defensible fuel profile zones (DFPZs), group selection, individual tree selection, avoidance or protection of sensitive areas, and riparian restoration could be used to promote healthy forests that provide both suitable habitat conditions for an array of wildlife species as well as a sustainable local economy.

The complexity of the original experiment-driven approach became unwieldy for managers to handle. As a result, the decision was made to drop efforts to develop a purposefully crafted landscape experiment where treatments were to be specifically placed in space and time to test response over entire landscapes. The redesigned study currently allows for treatments to be planned and implemented with the sole purpose of implementation of the HFQLG Pilot Project on the schedule anticipated for this program. Placement, size, intensity, and timing of vegetation management projects (i.e. fuels management and silviculture) will be dictated by the Pilot Project. Thus, there is no way to specifically direct the location, size, intensity, or timing of projects in order to facilitate an experimental design. However, the proposed research program is still designed to address key management questions, albeit through a more passive adaptive management approach.

The study has been subdivided into sub-components, or modules. Two of these are particularly relevant to the focus of this discussion and are highlighted below.

Fuels, Fire Behavior, and Fire Effects Module

The goal of this study module is to determine how landscape level fuels and silvicultural treatments affect potential fire behavior and effects. Data will be used to characterize fuels, forest structure, and fire behavior and effects prior to and after landscape fuel treatments. Study methods include remote sensing, extensive field sampling, and fire behavior and effects modeling. The primary questions are:

1. How do current fuels conditions affect potential fire behavior and effects?
   - What are current fuel loads and ladder fuel conditions prior to treatment?
   - What is the range of potential fire behavior given current conditions?
   - What are likely effects of fire behavior on these landscapes as determined by simulation models?
2. How will fuels treatments (i.e. DFPZs and other management applications) change fire behavior and effects?
   - How do defensible fuel profile zones (DFPZs) affect fuel loading?

- How does the placement of DFPZs affect potential fire behavior? Do they reduce the risk of catastrophic fire under extreme weather conditions?
- What effect would DFPZs have on resulting fire effects? Would the reduction in total fire extent and intensity reduce the severity and extent of canopy fires?
- And, in the very long-term, how do strategically places area treatments affect fuel loads and potential fire behavior?

California Spotted Owl Response Module

This module is designed to provide information on treatment effects at the individual site and population level scales. The following four questions will be addressed:

1. How are landscape-scale fuels treatments associated with California spotted owl density, distribution, population trends and habitat suitability at the landscape-scale?
   - The goal is to assess treatment effects on owl populations and their habitat within a habitat-modeling framework designed to improve understanding of wildlife habitat relationships and provide land managers with a tool to predict the effects of management actions on owls and their habitat. The study design will provide a general framework that can be responsive to changes in management objectives over time as management priorities evolve in response to changing ecological, societal or economic goals.
2. How are landscape fuels treatments associated with California spotted owl occupancy, diet, reproduction, and survival, and habitat fitness potential at the nest site, core area and home range scales?
   - The objectives at the home-range scale are: (1) determine owl habitat-use patterns and habitat selection; and (2) determine if there are differences in habitat quality or habitat fitness potential (i.e., owl survival and reproduction) associated with variation in habitat patterns. Each of the above questions will be assessed hierarchically at the nest-site, core area, and home-range scales within each owl home-range, as stronger associations between owl occurrence, demographic responses and habitat occur at the nest-site and core areas spatial scales within home ranges (Lehmkuhl and Raphael 1993, North et al. 2000, Franklin et al. 2000).
3. How are landscape-scale fuels treatments associated with California spotted owl habitat use, home range configuration, and habitat suitability at the nest site, core area and home range scales?
   - The objectives of this question are to determine behavioral responses and home range configuration, habitat use, and prey use patterns of a subset of owl pairs to treatments within core areas of home ranges. Radio-telemetry will be used to quantify habitat use, home range configuration, and habitat suitability pre- and post-treatment on a subset of CSO pairs that occur in areas that will be treated. Sampling will be opportunistic in response to where the Forests will be conducting treatments following the protocol for assessing treatment effects proposed by McDonald and McDonald (2002). The information generated to meet the objectives of this question will complement the information generated under Questions 1 and 2 listed above by providing finer-scale resolution data on the response of owls to treatments.

The Region has provided funds to conduct the Plumas/Lassen case study. The Pacific Southwest Research Station is matching this funding to execute a total of five modules that are part of this integrated research project. The additional related modules include examination of small mammal habitat associations, vegetation response to fuels treatments, and landbird response to treatments integrated across the landscape. An important consideration is that the focus of this work is on testing and understanding the

effects of an entirely different strategy for altering wildland fire behavior than is envisioned for the rest of the Sierra Nevada and for the HFQLG pilot project area after the pilot project is completed. For this competing strategy, all priority management questions for fire and the California spotted owl are addressed, albeit not in the context of a rigorous experimental design. However, the study does not contribute to learning about the effectiveness of the proposed fuels strategy (using strategically placed area treatments) or the effects of the strategy on the California spotted owl at a landscape scale. Nevertheless, some project-level questions about canopy closure and the relative significance of other habitat attributes can be addressed.

Status and Change Monitoring

Fisher & Marten Monitoring

The regional status and trend monitoring described in the adaptive management strategy of the SNFPA FEIS has been implemented during the past 2 field seasons (FY 02 and 03). The first complete sample of the fisher population monitoring program will be completed during mid-November 2003. Marten monitoring has involved completing assessment of the status of marten distribution in 2002, and full population monitoring during 2003.

Habitat monitoring is in development and will rely on a combination of FIA data, plot level vegetation data collected at population monitoring survey locations, and landscape models. The ongoing monitoring program is indispensable because it provides us the best information on the most important barometer of fisher population health in the Sierra: its distribution. As the fisher distribution increases and is restored to its former range, it will be easier to consider a variety of forest management options.

The results of the last 2 years of monitoring indicate that fishers are well distributed on the Sequoia and Sierra National Forests. In fact, comparing the recent distribution of detections on Sierra NF to those from about 6 years ago one could be tempted to conclude that the number of sites with detections is increasing. Should the population expand northward, continued monitoring will allow us to document expansion of the range into Stanislaus NF and north. This program is essential to updating our state of knowledge regarding the fisher's distribution and, as a result, determining whether management actions are either fostering the expansion of fishers in the Sierra Nevada, or at least not reducing the area of the occupied range.

Soil Productivity Monitoring

The need for Status and Change soil monitoring was evident when the FEIS was written and no quantified data about existing soil conditions over the Sierra Nevada region was available. It was therefore necessary to use a qualitative risk assessment to estimate the possible effects on soil productivity from implementing the chosen alternative (USDA Forest Service 2001, Sierra Nevada Forest Plan Amendment FEIS). The lack of knowledge regarding current soil condition and inability to quantitatively predict management effects creates a high level of uncertainty if the qualitative risk assessment accurately predicted potential effects on soil productivity.

Major management related effects, or affecters, which could reduce soil productivity, include the use of mechanical fuel treatments; prescribed burning, grazing, and OHV use. The soil quality standards (SQS) (see Sierra Nevada Forest Plan Amendment FEIS, Appendix F) define measurable soil properties to be used as indicators of soil health.

There has been no previous effort by Region 5 to monitor soil condition over large areas such as the Sierra Nevada. This study plan represents the first attempt to conduct status and change soil monitoring for the Sierra Nevada range.

A Soil Scientist was hired in August of 2003 to oversee the monitoring effort. Several Soil Scientists on Forests throughout the Sierra Nevada reviewed the draft study plan in July of 2003. The following decisions were made to proceed with the study plan completion.

FIA protocols and personnel will be utilized to collect data for consistency.

The Sierra Nevada will be stratified so that more samples would be gathered in zones of intensive management but other zones would also be monitored.

FIA protocols under Phase I and II that could provide useful information about soil condition would be utilized and other protocols would be developed that could be added on to the FIA procedures. The qualitative monitoring protocols would require less time to perform and would increase the number and frequency of observations and yet keep costs within budget.

Several of the same Soil Scientists are still to finalize the stratification and use of qualitative descriptors to provide a greater number of observations. Visual and qualitative classes of soil disturbance would be developed to identify soil displacement, indications of probable compaction and soil cover levels. It is anticipated that monitoring would start this coming field season.

Air Quality Monitoring

The Sierra Nevada is adjacent to some of the most severely degraded air quality in the nation. The San Joaquin and Sacramento Valley emissions impact terrestrial, aquatic, and visibility resources. Ozone concentrations are historically high and some Sierra vegetation exhibits injury that is likely pre-disposing it to more widespread insect, disease, and drought mortality. Sierra lakes are in the most chemically dilute (lowest capability of neutralizing acidic inputs) group in the U.S. making them extremely sensitive to acidification. Contribution of emissions from prescribed burning in forest treatments is being questioned by air quality regulatory agencies.

The Smoke Monitoring Plan developed in the Framework is a mechanism to develop data to support informed management and regulatory decisions. The small budgeted amount is largely used to facilitate other efforts in the Sierra that capitalize on very large well- funded assessments.

EPA relies on recommendations from the Forest Service in the issuance of permits to proposed facilities with significant emissions. The ozone and surface water project monitoring is currently allowing a credible response.

The Lake Monitoring Plan has had synoptic surveys completed in 7 of the 10 Class I areas in the study area. Lakes have been selected in those areas and 2 years of sampling has been completed by Forest staff.

The Ambient Ozone and Ozone Effects of Vegetation Study Plan was the basis for collaboration with California Air Resources Board (CARB) in 2001 to examine ozone transport in major drainages to the eastern Sierra. The Ambient Ozone and Ozone Effects of Vegetation Study Plan was critical in securing collaboration with CARB and EPA in continuing evaluation of pine plots throughout the Sierra from the Sequoia to Lassen.

A contract has been awarded to provide instrumentation and service near sensitive communities. This will include near real-time satellite data delivered to a web site providing assistance in management decisions. The Sierra and Stanislaus National Forests will deploy a limited number of instruments and will join in on the data service contract in 2004.

Meadow Monitoring

The proper ecological functioning of meadows ties to the viability of species dependent on meadow ecosystems. Vegetation condition provides information that addresses habitat needs of a suite of animal species. Study results will be used to determine whether the Sierra Nevada Forests are achieving desired

conditions and to gather baseline data on meadow condition. The data can be used to develop the baseline necessary for cause and effect monitoring.

Meadows have been selected randomly across the entire bioregion. Sample sites include grazed and ungrazed meadows. Selected meadows have different intensities of grazing and previously grazed meadows have been released from grazing for varied periods of time. Selected meadows support varied levels of recreational activities that can impact animal populations. Meadow monitoring is designed help explain the distribution of animal species that use meadow ecosystems. The plans for meadow monitoring and amphibian habitat monitoring were designed to compliment each other.

Vegetation Community Monitoring

A goal stated in the Sierra Nevada Forest Plan Amendment (SNFPA) FEIS was that forests with old-growth characteristics increase in both area, distribution, and continuity across national forest landscapes. To that end, the goal of this study plan is to describe the status of the quantity and quality of conifer and hardwood forest ecosystems throughout the SNFPA FEIS area and how they are changing over time. Continued monitoring allows for the only consistent way an evaluation of the current state of desired conditions and an assessment of trends toward or away from those conditions.

Data for status and trend monitoring of forest vegetation has been collected by FIA and contracted field crews for the last 3 field seasons using the majority of protocols outlined in the study plan. These include data on down woody debris and fuels in addition to vegetation. Additional data collected specifically for the study plan was collected over the last 2 field seasons. This data is currently being loaded into the new corporate database and the 2001, 2002, and 2003 data should be available for initial analysis within the next few weeks. In addition to the FIA plots, data from intensification plots designed by the RSL to measure vegetation in rare or unique vegetation types have been measured throughout the SNFPA area with the additional protocols designed for monitoring.

If the planned sampling rate is continued, the initial measurement will be completed by the end of FY 2006. This will produce an assessment of the current state of forest vegetation as it relates to desired conditions by spring of 2007. The analysis will also produce a SNFPA area estimate of fuel levels and their structure. Cause and effect studies related to vegetation and fuels management can be more clearly focused and, therefore, more cost effective using these results.

Landscape Map of Fire

The creation of fire severity maps will allow the assessment of not only how many acres have burned each year, but ***how*** each of those acres burned. Maps start with spatial vegetation data and fuels treatment data followed by the development of fire severity types. This could allow links to treatment methods that will reduce fire severity over the landscape. This type of information could allow the assessment of how well strategically placed treatments are changing fire severity at a landscape scale. It will enhance our ability to assess current fire regimes and compare those to “historical” fire regimes.

The fire monitoring program has been have collected data from 786 plots on USFS land and 143 plots on NPS land covering 13 large fires. This data will be used over the next year to finalize the fire severity maps.

Fire severity will also be mapped for all fires in the last 15 years and the data will be combined with current fires to define current fire regimes for two different Landsat scenes; one containing Lake Tahoe, and the other containing Yosemite National Park and the Stanislaus National Forest and the data will be combined with current fires to define current fire regimes. These areas will provide an immediate model for fire regimes in several vegetation types as well as allow us to better refine our data collection, processing and compilation for the next 8 years with ground verified data.

In FY04 mapping all fires greater than 1000 acres would continue with field data for ground verification of the maps. As discussed above, we will be using the model based on ground data to go backwards in time to create fire regime distributions for several vegetation types.

Amphibian Monitoring - Yosemite Toad and Mountain Yellow-legged Frog

Both the Yosemite toad and the mountain yellow-legged frog are USFWS candidate species (federal listing is warranted). Recent studies and assessments have indicated that these species are in decline. Yosemite toads have disappeared from more than 50% and Mountain yellow-legged frogs from 70-90% of historic localities. USFS management has the potential to contribute to the restoration or continued decline of these species. This monitoring provides essential data on occupancy patterns, the best indicator of population trends for these species. Results represent the entire range of the species which is the appropriate scale to assess their health and could determine whether the Forest Service is meeting desired conditions for Yosemite toad and mountain yellow-legged frog populations and habitat throughout their range in the Sierra Nevada.

The amphibian monitoring occurs in a random selection of small basins (3-4 km2 in size) to determine the status and trend of population (occupancy) and habitat for each species. 211 study basins throughout the species range were selected for monitoring. Basin size was reduced in 2003 after analysis of 2002 data. For efficiency, the study plans for the two species were integrated into one program with the same design and protocols. Sample basins are visited once in a 5-year monitoring cycle with 20% revisited annually. Population is measured by breeding occupancy (number of basins occupied by tadpoles or egg masses, number of breeding sites per basin) and relative abundance and demography in select basins. Habitat is measured by various attributes that assess 1) Hydrologic condition, 2) Habitat matrix, 3) Cover, 4) Water temperature, 5) Level of disturbance, and 6) General characterization of the habitat. A relational database in MS Access was developed for data storage.

Two years of occupancy and habitat data have been collected in basins distributed throughout the range of the species providing information on the Sierra-wide population. Both species have been found in a wider variety of habitats than initially expected. Meadows may be more important for the Mountain yellow-legged frog than initially expected. Both species have been found in slow-moving meadow streams. Both species have been found in the basins expected based on the study design.

Implementation of the Adaptive Management Strategy

Full development of the strategy will entail a number of steps, including, (1) identifying the most effective specific metrics for selected attributes, (2) determining the experimental design and sampling protocols, (3) determining sample size requirements to achieve desired levels of confidence and statistical power, (4) description of data analysis and evaluation techniques, (5) identification of management “checkpoints” that indicate the need for review or the achievement of a goal, (6) development of data bases and information management and sharing strategies, and (7) institutional response and collaboration mechanisms.

The following criteria will guide further refinement (i.e., design and implementation) of the adaptive management strategy:

- **Cost efficiency** - getting the most information for the least cost should be a high priority;
- **High yield of useful information** - information is useful for as many applications and across as broad a range of spatial scales as possible;
- **Engagement of management leadership** - the leadership and the staff of the Region need to be directly engaged in the process of implementation as possible to facilitate ownership, education, and timely application of information to management direction;

- **Quality control** - data collection and management should be designed so that quality control standards are applied evenly and effectively across all data collection points and efforts;
- **Scientific defensibility and credibility** - designs for data collection, quality control efforts, and data analysis techniques meet rigorous research standards, have the involvement of research, and should be peer-reviewed;
- **Timely yield of information** - he monitoring program must yield information for management in a timely manner;
- **Data management** - how do we most efficiently and effectively manage the volumes of data that are collected by so many different sources and for so many different purposes?

Incorporating Learning into Management Direction

The functions described below will need to be performed with strict reporting timeframes and annual status reports. In order for a program of this magnitude and scope to succeed there are two critical functions that must be fulfilled. The information that results from these efforts must be technically sound and scientifically credible. All interested parties should have faith in the results generate by this program. This requires the technical expertise to organize and execute the work and ensure defensible results that can be transmitted to all sectors of the interested agencies and public. Furthermore, the overall program requires oversight from the appropriate array of stakeholders such that the program is embraced and supported. This oversight drives the priorities and directs the technical efforts. Together the technical and policy functions will provide for the greatest opportunity for the adaptive management program to realize success. Specifically:

The *technical function* is responsible for:

- Ensuring the collection, analysis, and reporting of data and information
- Providing input into adaptive management study questions and study plan design
- Developing policy recommendations in response to new information, study results, emerging trends, etc.

These activities will be performed in a collaborative, coordinated manner with other state and federal agencies and Forest Service research scientists. Technical meetings, status reports, and policy recommendations will be scheduled on an annual timeline.

The *policy function* is performed through the review of technical recommendations and evaluation of current management policies in light of new information. This function will be performed in a collaborative manner with top leadership of state and federal agencies, Forest Service research and other members of the ad-hoc Interagency Team. Open, public meetings will be conducted to solicit input and feedback from stakeholders and the general public. At a minimum, a five-year review of the SNFPA will be conducted at the policy level, using all available information, including the annual reports generated by the technical function.

A *science function* is performed via consultation with the scientific community as the technical and policy functions are conducted.

2.3.4. Alternatives F2-F8 (SNFPA FEIS Alternatives 2-8)

Alternatives 2 through 8 of the SNFPA FEIS are briefly described here, referred to as Alternatives F2-F8. Readers can refer to the SNFPA FEIS, volume 1, chapter 2, pages 83-164, for more detailed descriptions of these alternatives.

Alternative F2 (FEIS Alternative 2)

Under Alternative F2, large reserves would be established where human management would be very limited to maintain and perpetuate old forest, aquatic, riparian, meadow, and hardwood ecosystems. Alternative F2 responds to views that ecosystems should be protected from all but minimal human-caused disturbances and that that natural environments are most desired.

Alternative F3 (FEIS Alternative 3)

Under Alternative F3, restoration of desired ecosystem conditions and processes by active management would be emphasized. These conditions would be determined through landscape analysis, monitoring, and local collaboration. Management activities would promote ecosystem conditions and processes that were within natural ranges of variability under prevailing climates.

Alternative F4 (FEIS Alternative 4)

Alternative F4 would involve an emphasis on the development of forest ecosystem conditions that anticipate and are resilient to large-scale, severe disturbances, such as drought and high intensity wildfire, which are common to the Sierra Nevada. This alternative is consistent with the view that ecosystems should be actively managed to meet ecological goals and socioeconomic expectations. Alternative F4 would have the largest acreage available for active management, including timber harvest.

Alternative F5 (FEIS Alternative 5)

Under Alternative F5, impacts from active management would be limited through range-wide management standards and guidelines. Existing undisturbed areas would be preserved, and other area would be restored to achieve ecological goals. Alternative F5 includes emphasis on reintroducing fire as a natural process and using fire to reduce fuel accumulations and fire damage.

Unroaded areas larger than 5,000 acres, ecologically significant unroaded areas between 1,000 and 5,000 acres, and inner zones of riparian areas would be preserved and left to develop under natural processes. Other areas, including old forest emphasis areas and general forest, would be restored under a limited active management approach to increase the amount of, and enhance processes associated with, old forest conditions. Under Alternative F5, impacts from management activities would be limited by imposition of range-wide management standards and guidelines.

Alternative F6 (FEIS Alternative 6)

Alternative F6 is an integration of old forest and hardwood conservation with fire and fuels management. This alternative includes direction for implementing a landscape-scale program of strategic fuels treatment in high-risk vegetation types across Sierra Nevada landscapes to: (a) reduce the potential for large severe wildfires, and (b) increase and perpetuate old forest and hardwood ecosystems, providing for the viability of species associated with them.

Alternative F7 (FEIS Alternative 7)

Under Alternative F7, a diversity of forest ages and structures would be established and maintained over the landscape in a mosaic approximating patterns that would be expected to be present under natural conditions, which include past, current, and future climates, biota, and natural processes. Ecosystems and

ecological processes would be actively managed to maintain and restore them to desired conditions. Silvicultural treatments could produce timber and other forest products.

Alternative F7 would involve few land allocations and application of a *whole forest approach*. Most lands would be allocated to *general forest*, where active management would be used to transform landscape conditions toward desired conditions. Management would be guided by desired conditions for CWHR classes and old forests, specific to the major Sierra Nevada forest types.

Alternative F8 (FEIS Alternative 8)

Alternative F8 involves a cautious approach to treating fuels in sensitive wildlife habitat. New information would be developed from research and administrative studies to reduce uncertainty about effects of fuels management on sensitive species. Until further guidelines were developed, treatments in suitable California spotted owl habitat would retain larger trees, high levels of canopy cover, canopy layers, snags, and down woody material.

2.4. Alternatives Considered but Eliminated from Detailed Analysis

The National Environmental Policy Act (NEPA) requires federal officials to rigorously explore and evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). As also required by NEPA, the range of alternatives considered in detail includes only those alternative that would fulfill the purpose and need for the proposed action described in chapter 1.

2.4.1. Set a Smaller Diameter Limit on Tree Removal

Suggestions have been made to set a maximum diameter for tree removal at less than 30 inches dbh (20-24 inches dbh, for example). This alternative was eliminated from detailed study because it does not respond to the purpose and need for action. Generally speaking, the requirement to retain 40% basal area in the largest trees will result in de facto diameter limit of less than 30 inches. Thus, a lower absolute diameter limit would add another constraint to project design without significantly affecting post-treatment conditions over most of the landscape. The existing direction (S1) includes an array of smaller diameter limits for fuels treatments (12 inches in old forest emphasis areas and California spotted owl home range core areas with some exceptions, 20 inches in general forest and threat zones, and 30 inches in defense zones). The SNFPA Review Team noted that existing diameter limit restrictions have significantly reduced managers' ability to design and implement cost-efficient fuels treatments, and contributed only marginally to meeting needs, especially given other standards and guidelines for canopy cover retention.[2] Canopy cover standards remain an integral part of Alternatives S1 and S2.

2.4.2. Apply the Standards and Guidelines in the Proposed Action to the HFQLG Act Pilot Project Area *and* Limit Group Selection in the Pilot Project Area to the Area Planned for the Administrative Study

The standards and guidelines in the proposed action (S2) are being applied in the pilot project area, with a few simple exceptions. Similarly, S1 applied standards and guidelines consistently over the bioregion, including the HFQLG Pilot Project Area.

The objective of providing a flow of products to meet community stability objectives, the management focus for the pilot project area is somewhat different than that for the larger bioregion. Therefore, group selection is proposed as intended by the Act

These differences would be maintained only through fiscal year 2009, at which time the HFQLG forests come under the management standards and guidelines proposed for the remainder of the bioregion or a separate forest plan revision. Because of the similarities of the standards and guidelines and the short duration of the pilot project, the suggested additional alternatives would not result in effects sufficiently different from those of Alternative S1 or S2.

[2] See for example, pages 15 and 40 in the SNFPA Review Team report (USDA Forest Service Pacific Southwest Region 2003).

2.4.3. Apply the Standards and Guidelines in the Proposed Action only to the WUI

This alternative was eliminated from detailed study because it does not respond to the purpose and need for action. Effective and efficient fuels treatments across all land allocations are needed to reduce the risk of catastrophic wildfire to both communities and important wildlife habitat. Adopting the proposed changes only in the WUI would not meet the need to implement an aggressive fuels reduction strategy in the wildlands. Moreover, this alternative would limit the Pacific Southwest Region's ability to embrace the goals of the National Fire Plan by preventing significant acreages of vegetation in fuels condition class 2 and 3 from being treated.

2.4.4. Include Forest Products as a Primary Management Objective

This alternative was eliminated from detailed study because it does not respond to the purpose and need for action. A need has been recognized to treat fuels in an economically efficient manner, which will require that some commercially viable forest products be made available as a by-product of fuels treatments. However, with the exception of the HFQLG pilot project area, the widespread production of commercial forest products is not addressed in this SEIS. Neither Alternative S1 nor S2 has changed the capable, available, and suitable (CAS) timber determination in forest plans. Alternative S1 and S2 did 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 revision. The schedule for forest plan revisions is available on the web at http://fsweb.wo.fs.fed.us/em/nfma/index2.htm.

2.4.5. Make Minor Changes to Individual Standards and Guidelines

Changes would include

- eliminating the requirement to leave part of a treatment unit untreated,
- increasing the diameter limits for certain tree species, and
- making slight adjustments in canopy cover requirements for certain land allocations.

These changes were adopted and analyzed in Alternative S2, along with some additional modifications to management direction. Relying on these changes alone would not respond to the purpose and need for action. Specifically, changing the metrics in the existing standards and guidelines would not address the fundamental problems of the prescriptive nature of the existing management direction (economic inefficiencies, complications with implementation, questionable effectiveness of fuels treatments, and inability to treat enough acreage with available funds to effectively modify fire behavior or be responsive to the goals of the National Fire Plan). Moreover, the suggested alternative would not provide local managers with the flexibility needed to choose from an array of tools and techniques to better address site-specific conditions.

2.4.6. Alternative S3 (Staged Implementation)

Alternative S3 would only implement the proposed action for fuels treatments (Alternative S2) in defense zones to protect the communities in the Sierra Nevada from catastrophic wildfire for the first five years. Four adaptive management studies would be initiated in the four demographic study areas for California spotted owls, to better understand the response of owls to various treatments designed to reduce and/or modify fire behavior. If reliable information were obtained from the adaptive management studies after five years, fuels treatments could be expanded to threat zones using the standards and guidelines of Alternative S2. Management outside of defense zones would be guided by the existing SNFPA ROD (Alternative S1), except in threat zones after five years, where Alternative S2 would apply contingent on the results of the adaptive management studies. Under Alternative S3, the HFQLG area would be guided by the same direction as applies to the rest of SNFPA planning area.

This alternative was dropped from further detailed study because it does not differ significantly from Alternative S1.

Applying S2 standards and guidelines in the defense zone closely mirrors S1 direction for the defense zone. Applying S1's standards and guidelines on the remaining landbase represent a continuation of Alternative S1 for five years. This represents a continuation of a cautious approach in the face of uncertainty. Whether results of adaptive management studies would be available in five years to inform changes in management is highly uncertain. Alternative S1 would likely continue as the operative management direction beyond five years. Alternative S2 provides the opportunity for learning to reduce uncertainty through the adaptive management program detailed in chapter 2.

Finally, Alternative S3 does not respond to the purpose and need and new information. Under this alternative, the HFQLG area would be guided by the same direction as the rest of the SNFPA planning area. As discussed earlier (see section 2.4.2), this would not allow for adequate testing of the suite of activities included in the HFQLG pilot project, thereby reducing the knowledge that could be gained from its full implementation.

2.5. Comparison of the Effects of the Alternatives

This section compares the alternatives by summarizing their environmental consequences. Note that environmental consequences for Alternatives F2 through F8 are fully described in the SNFPA FEIS and are only repeated in part in the SEIS.

2.5.1. Old Forest Ecosystems

All of the alternatives would maintain and enhance old forest conditions across Sierra Nevada landscapes. However, they would have different effects on:

- amounts and distribution of old forest conditions,
- potential losses of old forests to wildfire, and
- old forest ecosystem functions and processes.

Amount and Distribution of Old Forest Conditions

The number of large, old trees would increase under all alternatives. With a few exceptions for specific vegetation types or land allocations, all alternatives would have similar effects on the number of large, old trees because the upper diameter limit for tree removal would be 21 inches on the eastside and 30 inches on the westside (table 2.5.1a). The exceptions to these diameter limits are:

- Alternative S1 - Tree removal also would be limited to 12 inches in old forest emphasis areas and 20 inches in general forest and threat zones.
- Alternatives F3, F5, and F8 - In eastside mixed conifer and subalpine types, the upper diameter limit would be 24 inches.
- Alternative F4 - After 15-20% of national forest lands reach old forest conditions, trees greater than the 30-inch dbh limit could be harvested.

Table 2.5.1a. Comparison of Large Tree Retention and Old Forest Connectivity among the Alternatives.

Variable	Alternative								
	S1	S2	F2	F3	F4	F5	F6	F7	F8
Upper diameter limit for tree removal	30” west 24” east	30” west 30” east	30” west 21” east	30” west 21” east	30” west na east	30” west 21” east	30” west 21” east	defined by CWHR classes	30” west 21” east
Percent change in numbers of large trees by 2nd decade	+5.5%	+5.5%	+4.7%	+4.5%	+3.3%	+5.2%	+5.1%	+3.7%	+5.7%
Acreage of old forest allocation (millions of acres)	1.636	1.636	4.873	1.337	0.713	1.745	1.605	defined at project level	2.319

Note: west = westside; east = eastside

Alternatives S2 and F4 would include a larger upper diameter limit on the eastside (30 inches). This could result in tree removal in eastside habitats, which would prolong the time to increase old forest conditions. However, Alternative S2 would require that 30% of the pre-treatment basal area be retained in eastside habitats. This standard and guideline would help to maintain a component of older, larger trees. Alternative F7 would have tree diameter limits that vary by CWHR type.

All alternatives are designed to protect and maintain blocks of old forests (table 2.5.1a). Alternative F2 would meet this goal by establishing biodiversity reserves. The other alternatives would use the old forest emphasis land allocation for this purpose. Alternative F7 would define these old forest allocations through site-specific project level analyses. Alternatives having the most restrictive measures within old forests (e.g. S1) would probably result in the greatest protection for old forest conditions in the immediate future. However, as table 2.5.1b below shows, some alternatives (e.g. S2) would result in large reductions in wildfires, which may provide greater benefit in terms of the amount of old forest conditions available in the long run.

Potential Losses to Severe Wildfires

Over the last 30 years, wildfire in the Sierra Nevada has burned an average of about 43,000 acres per year. In the last ten years, the average has risen to about 63,000 acres per year. Table 2.5.1b below shows that reductions in the number of wildfire acreage burned each year are expected under all alternatives except F2 and F5.

Table 2.5.1b. Comparison of Annual Wildfire Acreage among the Alternatives.

Variable	Alternative								
	S1	S2	F2	F3	F4	F5	F6	F7	F8
Annual acreage of wildfire, first decade	64,000	60,000	68,561	65,804	61,730	69,008	65,705	64,800	67,002
Annual acreage of wildfire, fifth decade	63,000	49,000	76,315	48,381	44,380	71,933	49,579	49,340	62,988
Percent change in annual wildfire acreage from first to fifth decade	-2%	-22%	10%	-36%	-39%	4%	-33%	-31%	-6%

Alternative F4 has the greatest reduction in acres expected to burn annually, followed in order by Alternatives F3, F6, F7 and S2

Old Forest Ecosystem Functions and Processes

Alternatives F5, F6, and F8 would place the greatest emphasis on prescribed burning, and consequently the greatest emphasis on reintroducing fire as a process in old forest ecosystems. Alternatives F5 and F8 would place more restrictions on prescribed burning than Alternative F6. Alternative F6, however, would establish explicit priority on restoring fire as a process in old forests, which would be different than provisions of any other alternative. Alternative F6 would result in the greatest restoration of fire as a process in old forests. Alternatives F4 and F7 would include low to moderate amounts of prescribed burning. However, treatment locations rely more on local discretion, so the extent to which these alternatives would restore fire to old forests is unknown. While Alternative F8 involves higher levels of prescribed burning, provisions in its standards and guidelines would limit the extent of this burning and therefore the amount of fire restoration in old forests. Alternative F2 entails very little prescribed burning and thus minimal restoration of fire to old forests.

Alternatives having the highest likelihood of connectivity between large blocks dedicated to old forests in order are Alternatives F2, F5, F3, F8, and F6. Alternative F4 would involve moderate-sized blocks dedicated to old forests, but the blocks would be widely distributed and therefore more limited in providing connectivity. Alternatives F3, F4, F5, F6, F7, and F8 would include provisions for maintaining old forest patches in the general forest, which would contribute to old-forest connectivity.

Alternatives S1 and S2 include the use of prescribed fire as a treatment method. Alternative S1 embodies a strong preference for the use of prescribed fire as the treatment method in several allocations, such as spotted owl and northern goshawk PACs outside of defense zones; however, limitations due to needs of smoke management and due to high existing fuel loadings may hamper some prescribed burn projects. Alternative S2 would allow more use of mechanical treatments as the initial treatment, with prescribed burning as the follow-up treatment, but requires use of prescribed burning as the initial treatment in PACs outside WUIs.

2.5.2. Aquatic, Riparian, and Meadow Ecosystems

The greatest effects on the Aquatic, Riparian and Meadow Ecosystems will generally be from either mechanical fuel treatments or catastrophic wildfires. The other potential effects from activities such as grazing, mining, pesticide use etc. will either affect only specific sections of the landscape such as meadows or their effects are constant across alternatives. When the balance between fuels treatment acres and risk of catastrophic wildfire is assessed, alternatives that lower the risk of fire and have medium levels of treatment pose the least risk to aquatic and riparian systems. This means that Alternatives F3, F6,

S1, and S2 are expected to pose the least risk of negatively impacting riparian and aquatic ecosystems, Alternatives F4 and F7 an intermediate level; and Alternatives F2, F5, and F8 the highest.

Another consideration is the size of material removed and the retention requirements for forest stands. Erman and Erman (2000), found that large openings negatively affect the microclimate of the riparian zone. This means that alternatives that remove smaller material and require higher crown closures will have a greater benefit to the aquatic and riparian ecosystem. Using these criteria, Alternatives F2, F5, F8, S1 and S2 would have the least impact. However, the risk of catastrophic wildfire, which would have a profound effect on forest openings, is high in Alternatives F2 and F5. Thus Alternatives F8, S1 and S2 would have the least overall impact on long term forest structure surrounding riparian areas.

Other factors such as the requirement for landscape analysis, peer reviews, and special protection for sensitive species are components of alternatives that will provide increased protection for the aquatic and riparian ecosystems. Alternatives F3, F5, and S1 all require landscape assessment. These analyses will provide important context to management decisions and allow decisions to consider impacts to and needs of species outside of the immediate project area. The Conservation Assessments completed under Alternative S1 and S2 will inform management decisions in all aquatic and riparian habitats. It will provide some of the basic information needed to better manage habitats for these species. The creation of Critical Refuges in Alternative F5 and Critical Aquatic Refuges in Alternative F2, F6, F8, S1 and S2 will also provide special protection for sensitive species. The conservation assessments and refuges are important first steps in the development of conservation management strategies for aquatic and riparian dependent species.

Alternative S2 may pose higher short-term risks to aquatic resources because it prescribes larger amounts of mechanical treatments and greater treatment intensities. However, these are expected to reduce long-term effects associated with wildfire. Short-term risks associated with S2 will be greatly reduced through the application of the same Aquatic Management Strategy with similar standards and guidelines. Specifically, landscape and project-level analysis, attainment of RCOs, implementation of proven BMPs and other standards and guidelines, a modest reduction in overall road miles, and improved road conditions are the most important aspects of reducing risks to aquatic resources.

Based on all of the above factors, Alternative S1 best protects the values associated with aquatic and riparian habitats. Alternatives S2, F3 and F6 follow closely. The other alternatives have pluses and minuses in their ability to protect riparian and aquatic values. While Alternatives F4 and F7 reduce the risk of wildfire, they lack specific guidance that would provide protection to aquatic and riparian species. On the other hand, Alternatives F2, F5, and F8 provide protective management measures; they also pose the highest risk of catastrophic wildfire.

2.5.3. Fire and Fuels

Weather, topography and fuels influence the behavior of fires. All alternatives influence fires in the Sierra Nevada through a fire suppression program and modification of fuels and vegetation. The annual acreages of wildfire projected for each alternative are presented above in table 2.5.1b. The greatest reduction in the annual acreage of wildfire within the first 5 decades would occur (in decreasing order) under Alternatives F4, F3, F6, F7, S2, F8, and S1. Alternatives F2 and F5 are projected to increase the acreage burned.

Modifying fuel loading across the landscape can effect changes on wildfire behavior by reducing fire intensities and rates of spread. This program also results in safer, more efficient fire suppression efforts. Table 2.5.3a below displays the acreage of fuel treatment (mechanical and prescribed burning) projected for each alternative. Alternatives that accomplish more acres of treatment should result in reduced wildfire severity as well as improved fire suppressions. The alternatives that are projected to modify fuel loadings and change fire behavior the most are F4, F7, F6, S2, and S1, in that order. Alternatives F3, F8,

F5, and F2 involve treatments, but on smaller acreages. Note that the estimates in table 2.5.3a do not show the relative effectiveness of fuel modifications by alternative.

Table 2.5.3a. Comparison of Extent of Mechanical and Prescribed Fire Fuels Treatments among the Alternatives.

	Alternatives								
	S1 _1/	**S2**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
Annual acreage of mechanical fuels treatment	51,345	72,200	7,022	30,081	86,168	9,858	33,381	70,045	13,867
Annual acreage of prescribed burns	49,560	42,020	15,457	53,582	46,760	39,356	82,747	60,113	69,038
Total acrege treated annually	100,905	114,220	22,479	83,663	132,928	49,214	116,128	130,158	82,905

_1/ acres based on gross treatment acres

2.5.4. Focal Species

California Spotted Owl

Under all alternatives the quantity and quality of useable habitat available for the California spotted owl is projected to increase across the species range. The alternatives are distinguished by differences in the amount of habitat and management of individual owl nest locations and home range areas. Alternative F4 is projected to produce slight declines in high quality habitat and would not protect all nest (and primary roost) stands. Among the remaining alternatives, Alternative F7 is projected to provide lower amount of useable habitat. Alternatives F2, F3, F5, F6, F8, S1 and S2 would protect all nest stands and have the highest projected increase in habitat values. These alternatives would provide positive benefits to California spotted owls, Alternative F2, F5 and F8 would limit activities within owl home ranges to a greater extent than would the other alternatives, and they could provide increased short-term protection. Improved understanding of relationships between owl habitat patterns at the home range scale and owl demographics, and application of this knowledge at smaller scales, would reduce the risks of implementing any of the alternatives. Alternative S2 has fewer restrictions on treatment methods and intensity within PACs and HRCAs than would Alternative S1.

Northern Goshawk

Alternatives F3, F5, F6, F8, S1 and S2 would provide the greatest contribution to maintaining and enhancing conditions for northern goshawk throughout the Sierra Nevada. These alternatives would protect all goshawk territories, and all are projected to increase amounts of high suitability habitat. Alternatives F4, F7, and S2 would provide less certainty about effects relative to the other alternatives because of the higher rates of mechanical treatments; however, they would provide greater protection from loss due to natural disturbance events.

Willow Flycatcher

The alternatives involve different approaches to managing and conserving willow flycatcher habitat and populations. Alternatives F2 and F8 would result in the greatest improvement in conditions for this species during the breeding season. Given the available data and uncertainties, Alternative F2, which excludes livestock grazing year-round in occupied willow flycatcher habitats, presents the greatest potential benefits to the species. Of all the action alternatives, Alternative F2 is the most likely to support

long-term distribution and abundance of this species in Sierra Nevada national forests. Furthermore, Alternative F2 excludes grazing in meadow habitat within 5 miles of occupied sites, allowing for restoration and potential re-colonization of unoccupied sites and the opportunity for willow flycatcher population expansion and recovery.

Alternatives F3, F5, F6, S1 and S2 would provide slightly less improvement of conditions affecting the willow flycatcher than Alternatives F2 and F8. Alternatives F3 and F5 would provide more stringent guidelines than other Alternatives regarding general streambank use but weaker protections than Alternatives F2 and F8 specific to willow flycatcher habitat. Alternatives F3, F4, and F7 would provide an equal to slightly greater level of improved conditions associated with the willow flycatcher.

Alternatives S1 and S2 would apply the AMS and similar standards and guidelines for aquatic, riparian, and meadow ecosystems, to accomplish the same objectives. Alternative S2 involves slight differences relative to S1 where grazing surveys have not been completed, and it allows development of a site-specific management plan to address grazing management where occupied habitat exists. These alternative management strategies are locally determined and are designed to provide sufficient protection of this species.

Forest Carnivores

Four forest carnivores of special concern were identified: marten, fisher, wolverine, and Sierra Nevada red fox. The marten and fisher would more likely be directly affected by all alternatives than would the rarer wolverine and Sierra Nevada red fox, which are associated with higher elevations where relatively little management would take place. Consequences of the alternatives to these species were evaluated in terms of: (1) changes in vegetation structure and composition, (2) recreation and roads, and (3) survey requirements and site protection.

Fisher

Alternatives F5 and F8 would result the greatest improvements to fisher persistence and habitat. Both alternatives would provide fisher habitat through their provisions for retaining and recruiting large trees, snags, and coarse woody debris; retaining dense forest canopy; and promoting hardwoods on conifer sites.

Alternative F2 would provide habitat protections similar to Alternatives F5 and F8; however, because Alternative F2 relies primarily on fire suppression to manage the threat of severe wildfires, the risk of catastrophic fire would be higher under this alternative.

Alternative F3 would result in less benefit to fishers in terms of dead and down wood and hardwoods on conifer sites than either Alternative F5 or F8. Under Alternative F6, canopy closure in denning areas could be reduced to 40% in developed areas within urban WUIs.

All of the action alternatives would protect fisher den sites from human disturbance; however, none of the alternatives would reduce road-related risks to the same extent as Alternative F5. Alternative F5 would reduce potential recreation-related impacts in close proximity to fisher locations and would reduce the impacts of roads and related human disturbance by reducing road density and protecting unroaded areas.

Alternatives F4 and F7 would cause no change or slight increases in fisher habitat and population relative to the other alternatives. Alternative F4 could result in lower fisher abundance and distribution, as it would slightly decrease the availability of habitat elements important to fishers. Alternative F7 would reduce forest canopy from levels required for denning habitat to levels suitable for travel and foraging habitat, but would not change habitat conditions from the current situation.

Alternatives S1 and S2 are similar in projected amounts of fisher habitat over time, with differences primarily due to predicted change in habitat reduction from large wildfires. Under both alternatives a conservation assessment would be completed that could be used to develop a conservation strategy to improve management consistency across the species range. This assessment, coupled with ongoing research, should reduce the level of uncertainty regarding proposed treatments.

Marten

Environmental conditions important to marten and marten population would not be expected to change significantly from the current condition under any of the alternatives. All alternatives would result in retention and development of large trees at levels sufficient to protect and enhance marten habitat.

Under Alternatives F5, F6, F8, S1 and S2 new recreational developments would be evaluated for compatibility with marten needs when they were proposed in suitable marten habitat. In addition, Alternative F5 would reduce the impact of roads and related human disturbance by precluding roading of unroaded areas.

Alternative F2 provides direction for protecting marten habitat; however, this alternative would result in an increased risk of catastrophic fire, which could reduce habitat for this species. Compared to Alternatives F5 and F8, Alternative F3 would provide less dead and down wood and hardwoods on conifer sites.

Alternative F4 would only slightly decrease overall environmental conditions and predicted populations compared to the current condition. Alternative F4, S1 and S2 would reduce forest canopy cover in treated areas because it would establish and maintain both DFPZs and SPLATs. Alternatives F4 and F7 would provide less snag protection, which could lead to lower levels of recruitment of coarse woody debris over time. Alternative F4 has the highest level of fuels treatment and could result in less coarse woody debris recruitment. Alternative F7 emphasizes mechanical treatments over prescribed fire, possibly reducing coarse woody debris recruitment.

Sierra Nevada Red Fox

Although the current distribution of the Sierra Nevada red fox in California is uncertain, the species' range appears to have contracted from the continuous distribution described by Grinnell in the 1930s. Of all the alternatives, Alternative F5 would likely lead towards the greatest improvement in environmental conditions for and population of Sierra Nevada red fox, because it provides the greatest level of meadow protection, emphasizes reducing road densities across landscapes, and encourages new Sierra Nevada red fox surveys. Alternatives F3 and F5 would involve restrictions on recreational activities in unroaded areas. Alternatives F5, F6, and F8, would require detailed evaluation of recreational development on the basis of Sierra Nevada red fox detections and the presence of suitable habitat. Alternatives F6 and F8 would not require surveys, and these alternatives place fewer restrictions on recreation and roads. Alternatives F4 and F7 would provide more of the open forest habitat preferred by the Sierra Nevada red fox than would Alternative F5; however, Alternatives F4 and F7 would place fewer restrictions on recreation and would provide only moderate reductions in roads. Alternative F2 would prohibit off-highway vehicle and over-snow vehicle use in den site buffers. Alternative F2 would not require new surveys for the Sierra Nevada red fox.

Alternatives S1and S2 have similar effects on Sierra Nevada red fox. Alternative S2 clarifies direction to validate sightings of this species by a forest carnivore specialist and clarifies the implementation of a limited operating period to better ensure that it is applied when warranted to reduce the potential to disturb breeding individuals.

Wolverine

Consequences to wolverines are primarily influenced by: (1) recreation and roads and (2) survey requirements and site protection. Based on the combined categories, Alternatives F5, F8, S1, S2 would likely result in the greatest benefit to wolverine persistence and recovery. Alternatives F5 and F3 would restrict recreational activities in unroaded areas. Alternative F5, F6, and F8 would require evaluation of recreational development on the basis of wolverine detections and the presence of suitable habitat. Alternative F5 would emphasize reducing road densities and would encourage new surveys. Alternative F3, S1 and S2 would not provide the same level of benefits as Alternatives F5 and F8 because it would not require surveys, however it would limit activities around locations of verified wolverine sightings.

All Alternatives would increase the extent of suitable wolverine habitat from the current condition, with increases ranging from 5.4 to 9.1%. Alternatives F4 and F7 would result in only slight increases. However, these increases are not significant because none of the alternatives substantially affect the vegetation associated with wolverine habitat, either as interpreted from the standards and guidelines or from habitat utility values projected by the CWHR model. Alternatives F4 and F7 would not encourage surveys, and they would have greater potential for new road development than the other alternatives.

Alternative F2 would pose more risks related to the effects of roads and survey requirements than Alternative F5, but would generally provide greater benefits to wolverines than Alternatives F4 and F7.

As with the Sierra Nevada red fox, Alternatives S1 and S2 would have similar effects on this species. Alternative S2 applies the same clarification regarding verification of sightings by a forest carnivore specialist and implementation of a limited operating period as described for the Sierra Nevada red fox.

Amphibians

Foothill Yellow-Legged Frog

Alternatives F2 and F5 appear to provide the greatest level of protection to the foothill yellow-legged frog, because they provide the most effective management approaches for this species' persistence and recovery. Alternatives F3, F6, F7, and F8 would provide a slight improvement from the current condition. Alternative F4 would decrease environmental conditions compared with the current condition. Information and research gaps, especially regarding the impacts of livestock utilization standards for grass and shrubs on the foothill yellow-legged frog, add uncertainty to this assessment.

Alternatives S1 and S2 apply the AMS and the same standards and guidelines for aquatic, riparian, and meadow ecosystems. These alternatives protect discovered populations by designating critical aquatic refuges (CARs).

Mountain Yellow-Legged Frog

Alternatives F3, F5, F8, S1 and S2 would likely result in the greatest improvements in populations of mountain yellow-legged frog, because they provide the most effective management approaches for this species' persistence and recovery. Alternatives F4, F6, and F7 would result in less improvement in population numbers.

Alternatives S1 and S2 incorporate the AMS and the same standards and guidelines for aquatic, riparian, and meadow ecosystems. These alternatives protect discovered populations by designating CARs. Some mountain yellow-legged frog populations may exist within habitat for the Yosemite toad, willow flycatcher, or great gray owl. Alternative S2 changes some of the grazing management standards and guidelines related to these species, which could potentially indirectly affect the mountain yellow-legged

frog. However, changes in grazing management would require site-specific analyses, including biological evaluations that would address all species occurring within the affected area. Thus, the implications of such changes would likely be minimal.

The U.S. Fish and Wildlife Service has determined that a listing of this species under the federal Endangered Species Act (ESA) as threatened is warranted, but action towards listing is currently precluded due to other priorities. If this species is formally listed in the future, changes in management direction may be warranted.

Yosemite Toad

Alternative F8 would result in the greatest improvement of environmental conditions for the Yosemite toad, because it would provide the most effective management approach for this species' persistence and recovery. Alternatives S1 and S2 will most likely have similar results to F8, but have increased risk associated with some potential for late season grazing effects. Alternatives F2, F3, and F5 would result in slightly less improvement, because of lack of specific direction limiting livestock grazing where the species is present. Alternative F2 includes provisions for establishing an amphibian reserve system to protect known occupied and suitable unoccupied amphibian habitats (FEIS Appendix D, standard and guideline AM12). Alternatives F3 and F5 would protect, known, occupied amphibian habitats. These are based on records over the last 25 years (FEIS Appendix D standard and guideline AM13). Alternative F4 would provide for improvement from the current condition.

Alternatives S1and S2 applies the AMS and the same standards and guidelines for aquatic, riparian, and meadow ecosystems. These alternatives protect discovered populations by designating CARs. Alternative S2 changes some of the grazing management standards and guidelines related to the Yosemite toad. It allows use of alternative management strategies that are locally determined to provide sufficient protections for this species. Although the intent of these alternative management strategies is to provide for and protect habitat for the species, some difficulties in implementation may increase the risk of success in avoiding impacts to Yosemite toads. Some of these risks would arise with Alternative S1 as well and are due to the difficulty in managing livestock in the forest environment.

The U.S. Fish and Wildlife Service determined that a listing of this species under the ESA as threatened is warranted, but action towards listing is currently precluded due to other priorities. If this species is formally listed in the future, changes in management direction may be warranted.

Cascades Frog and Northern Leopard Frog

Alternatives F5, F8, S1 and S2 would likely result in the greatest improvement of conditions for the Cascades frog and northern leopard frog, because they provide the most effective management approaches for this species' persistence and recovery.

Alternatives S1 and S2 apply the AMS and the same standards and guidelines for aquatic, riparian, and meadow ecosystems. Under these alternatives, populations would be protected as they are discovered by designating CARs. Some populations of these species may exist within habitat for the Yosemite toad, willow flycatcher, or great gray owl. Alternative S2 involves changes to some of the grazing management standards and guidelines related to these other species, which could potentially indirectly affect these frog species. However, changes in grazing management would require site-specific analyses including biological evaluations that would address all species occurring within the affected area. Thus, the implications of such change would likely be minimal.

2.5.5. Socio-Economic Concerns

Economy

National forest management directly affects the socioeconomic environment of the Sierra Nevada through employment and income derived from resource extraction, production, and use. Timber harvest from national forest lands provides a flow of products to area industries.

Alternatives F4, F7, and S2 would provide the largest number of jobs annually in the commercial logging sectors. Consequently, these alternatives would also result in the highest estimated annual earnings in these economic sectors. (Table 2.5.7a)

Table 2.5.7a. Comparison of Estimated Average Annual Employment and Earnings from Commercial Timber Harvests on National Forests among the Alternatives in the First Decade.

	Alternative								
	S1	**S2**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
Estimated average annual jobs	957	1,894	145	566	3,467	322	526	2,730	222
Estimated average annual earnings (thousands $, 1995)	38,344	57,159	7,458	26,099	116,023	14,345	26,136	89,913	12,212

Commercial Forest Products

Table 2.5.7b displays the modeled annual yield of green and salvage harvests by alternative for the first two decades. These estimates include the timber volumes produced under the HFQLG pilot project. The amount of salvage volume projected for each alternative is well less than the amount of annual mortality (700 million board feet [MMBF]) estimated for these forests in the SNFPA FEIS (volume 2, page 380).

Six of the alternatives would produce volumes exceeding 100 MMBF annually. In decreasing order of volume production, these alternatives are F4, F7, S2, F6, F3 and S1. The remaining Alternatives (F5, F8, and F2) would produce less than 100 MMBF annually. For comparison, the average amount of timber offered during the six years following adoption of the California spotted owl guidelines (CASPO guidelines) (1994-1999) was 372 MMBF per year.

The amount of green volume offered in the second decade is less than in the first for each alternative. Maintenance of previously treated areas will be a significant part of the annual program of work, which will result in less volume offered.

Table 2.5.7b. Comparison of Estimated Annual Timber Harvest Volume (Green and Salvage) Offered for Sale from National Forests among the Alternatives (MMBF/yr).

	Alternative								
	S1	**S2**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
First Decade									
Salvage timber	30	90	17	33	238	29	91	142	42
Green timber	70	329	22	84	534	49	80	414	33
Total timber	100	419	39	117	722	78	171	556	75
Second Decade									
Salvage timber	30	90	17	33	238	29	91	142	42
Green timber	20	132	7	21	294	7	57	210	14
Total timber	50	122	24	54	522	36	148	352	56

Table 2.5.7c summarizes the estimated commercial biomass output that could be available for sale under each alternative by decade. Alternative S2 is projected to produce the largest amount of commercial biomass, followed by Alternatives F7, F4, and S1. The other alternatives would produce between 9% (Alternative F2) and 41% (Alternative F6) of the amount of biomass produced by Alternative S2.

Table 2.5.7c. Comparison among the Alternatives of Potential Commercial Biomass Output from National Forests in the First Decade (1,000s of bone dry tons).

Alternative								
S1	**S2**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
4,385	7,021	660	2,440	6,200	1,710	2,910	6,680	1,720

Grazing

All alternatives would reduce the current numbers of livestock permitted to graze on national forest lands because total forage (as measured by animal-unit months) offered by the national forests would decline (table 2.5.7d). Alternatives F4 and F7 would have more suitable rangeland (acreage available for grazing) than the other seven alternatives.

Table 2.5.7d. Comparison among the Alternatives of Reduction in Animal-Unit Months Offered by National Forests.

Alt S1	Alt S2	Alt F2	Alt F3	Alt F4	Alt F5	Alt F6	Alt F7	Alt F8
83,000	83,000	140,000	69,000	56,000	172,000	72,000	56,000	110,000

Alternatives F2, F5 and F8 would establish more conservative standards and guidelines related to grazing activities than would the other alternatives. These standards and guidelines would remain in effect on a particular range until a range analysis could be completed to determine the range condition. In many cases, these conservative standards would make it uneconomical for permittees to graze their allotments while waiting for an analysis to be completed. Because many years would be required to complete analyses of several hundred allotments on the Sierra Nevada national forests, many permittees would probably give up their permits.

Alternatives F4 and F7 would cause the least reduction in grazing use. F2, F5, and F8 would cause the greatest reductions in grazing use. The intermediate alternatives in order of least to greatest reduction in grazing are F3, F6, and S2/S1.

Alternatives S1 and S2 were further evaluated by estimating effects on allotment permittees. By employing alternative strategies to protect wildlife species, Alternative S2 is estimated to eliminate the grazing deferral described above for 14 allotment permittees, whereas Alternative S1 would require grazing deferral by these 14 allotment permittees. Seven permittees would be very highly impacted by both Alternatives S1 and S2. (Table 2.5.7e)

Table 2.5.7e. Comparison of Effects to Permittees between Alternatives S1 and S2.

	Alt S1	Alt S2
Number of permittees slightly affected	11	7
Numbers of permittees moderately affected	17	10
Number of permittees highly affected	12	9
Number of permittees very highly affected	7	7

Roads

The forest development road arterial system would remain in its current location in Alternatives F2-F8 and S1. No arterial roads would be decommissioned. Improving arterial roads would continue to be a priority for road construction funding.

The forest development road collector system would also remain in its current location in these alternatives. Construction or decommissioning of collector roads would be unlikely. Collector roads would be improved and managed to provide a more stable road surface, primarily using gravel and dust abatement.

The most substantial changes in the forest development road system would be changes in the mileage and conditions of local roads. Some roads would be improved to reduce impacts on adjacent resources, but typically local roads have lowest maintenance priority. Some local roads may become undriveable due to vegetative encroachment. The mileage of local roads would decrease, because some local roads would be decommissioned.

The mileage of unclassified roads would also decrease. Unclassified roads would be evaluated as they were encountered during planning of vegetation treatments. Some unclassified roads (e.g. those supporting unauthorized uses) would be decommissioned. Others providing needed access would be improved and added to the forest development road system. In some areas the size of the forest development road system would increase as needed roads were added to it. If these roads were supporting authorized uses, adding them to the forest development road system would not affect existing public access.

Alternative S2 would result in different effects on the roads system than the other alternatives. Alternative S2 would allow construction, maintenance, and decommissioning of roads in support of full implementation of the HFQLG pilot project. This will result in an increase in the mileages of the forest development collector system and local road system, along with decommissioning other roads.

Air Quality

Emissions of particulate matter larger than 10 microns (PM_{10}) would be expected to differ by alternative in proportion to the acreages of wildfire and prescribed burning that would occur. Total emissions are

expected to increase over time for Alternatives F2 and F5, given the projected increase in wildfire acres. All other alternatives (S1, S2, F3, F4, F6, F7, F8) should result in a reduction in total emissions, simply as a result of wildfire reduction.

Table 2.5.7f displays annual emissions of PM_{10}, based on acreages of wildfire and prescribed burning projected for each alternative. Comparison of all alternatives shows 43% difference in annual emissions between the lowest emitting (S2) and highest emitting (F6) alternative. Although Alternatives S2 and S1 would involve larger acreages of prescribed burning than under Alternative F2 (Table 2.5.3a), Alternative S2 would result in the lowest total PM_{10} of all of the alternatives. This result is due primarily to the relatively small acreage burned by wildfire under this alternative and because mechanical treatments would be used extensively to reduce fuel loadings prior to prescribed burning. Alternative S1 would result in the next lowest total PM_{10} emissions.

Mechanical fuels treatments can reduce the amount of particulate from wildfires and from prescribed burns. As shown in Table 2.5.3a, Alternatives F4, S2, S1, and F7 include the largest amount of annual mechanical fuel treatments. Over time (decades), particulate emissions from wildfires as well as prescribed burning on treated areas should diminish.

Timing of prescribed burns helps reduce particulate emissions during periods of critical air quality. Because all projects are to be designed to keep smoke emissions from causing violations of ambient air quality standards, all alternatives are consistent with provisions of the Clean Air Act.

Table 2.5.7f. Comparison of Particulate Emissions among the Alternatives in the First Decade (Tons of PM_{10})

	Alternative								
	S1	**S2**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
Annual wildfire emissions	23,700	22,600	25,300	24,300	22,800	25,500	24,200	24,000	24,700
Annual prescribed fire emissions	2,000	2,400	3,500	12,600	11,900	9,200	18,100	13,900	14,500
Total annual emissions	25,700	25,000	28,800	36,900	34,700	34,700	42,300	37,900	39,200

Recreation

In general, all of the alternatives could have localized effects on certain types of recreation activities on national forest lands. Alternatives F2, F3, F5, F6 and F8 would cause a slight reduction in the number of recreation visitor days (RVDs). These alternatives would favor a trend toward more dispersed, non-motorized recreation, such as hiking and backcountry camping. Alternatives F4 and F7 would maintain the current level of RVDs.

Alternatives S1 and S2 would have similar effects on recreation. Alternative S2 clarifies direction contained in Alternative S1 to explicitly apply limited operating periods for protection of various wildlife species to vegetation treatments and not to recreation related activities. However, new recreation activities still require analysis under NEPA, and recommendations for limited operating periods could be adopted as deemed necessary at the project level. Alternative S1 includes direction that may limit recreational pack stock activities in meadows containing or potentially containing willow flycatchers and/or Yosemite toads.