Environmental Assessment

Sagehen Project

United States
Department of
Agriculture

Forest Service

Pacific Southwest Region

Tahoe National Forest
Truckee Ranger District

Pacific Southwest
Research Station

March, 2013

TABLE OF CONTENTS

Chapter 1: Purpose, Need and Proposed Action 9

Introduction 9

Background of the Sagehen Basin 10

Need for the Sagehen Project 13

Reducing hazardous fuel loadings and modifying landscape-scale wildland fire behavior 13

Maintaining and enhancing habitat for the marten and other wildlife species associated with late seral forest habitat 14

Creating heterogeneous forest stand conditions that would be expected to develop under an active fire regime 15

Enhancing the ecological role of fire 15

Restoring declining aspen stands within unit boundaries 15

Purpose of the Sagehen Project 16

Proposed Action 17

History of the Proposed Action 19

How the Proposed Action was Developed through Collaboration 20

Collaborative Process 20

Steps Used to Craft the Proposal 20

Decision Framework 23

Forest Plan and Management Direction 23

Public Involvement 24

Issues 24

Chapter 2: Alternatives 27

Alternative 1: Proposed Action 27

Overall Goals and Treatment Objectives 27

Prescriptions and Treatments 33

Order of Prescription Application 33

Silvicultural Prescriptions 33

Silvicultural Treatment Methods 43

Fire/Fuels Prescriptions 44

Fire/Fuels Treatment Methods 45

Unit-Specific Prescriptions and Treatments 48

Prescription Metrics 51
Basal Area 52
Canopy Cover 53
Snag Density 53
Down Woody Material 54
Short Snags/High Stumps 54
Dense Cover Areas and Early Seral Openings 55
Tree Species Composition 55
Prescribed Surface Fire Behavior 55
Road Management 56
Alternative 2: No Action 57
Alternative 3: Non-commercial Funding 57
Prescription and Treatment Method Definitions (associated treatment areas): 59
Silvicultural Prescriptions 59
Silvicultural Treatment Methods 61
Fire/Fuels Prescriptions 62
Fire/Fuels Treatment Methods 63
Road Management 64
Standard Management Requirements 64
Monitoring 64
Comparison of Alternatives 67
Chapter 3: Environmental Consequences 73
Element 1. Impacts that may be both beneficial and adverse (40 CFR 1508.27 (b)(1)). 74
Forest Vegetation 74
Indicators Used To Analyze Impacts To Forest Stands 74
Stand Density 74
Medium and Large Trees 74
Tree Mortality 75
Canopy Cover 75
Variability 75
Methodology And Assumptions 75
Existing Conditions 76

Post-Treatment Conditions 76
Projected Conditions 76
Direct and Indirect Effects 76
Fire and Fuels 88
Indicators 89
Methodology 89
Alternative 1 (Proposed Action) 90
Alternative 2—No Action 91
Alternative 3—Non Commercial Funding Alternative 92
FARSITE Modeling Scenarios for the Alternatives 92
Soil Productivity 94
Direct and Indirect Effects to Soil Cover, Organic Matter and Duff 95
Direct and Indirect Effects to Soil Porosity and Compaction 96
Hydrology 97
Direct and Indirect Effects 99
Wildlife 105
Species and Habitats Not Affected by Sagehen Project 106
Metrics for Analyzing Direct and Indirect Effects 106
Effects Common to All Wildlife Species 107
Species Specific Potential Effects 121
Aquatic Wildlife 207
Species Specific Determinations 208
Plants 220
Affected Vegetation Communities in the Sagehen Basin 220
Direct and Indirect Effects to Sensitive Plant and Fungi Species 221
Air Quality 221
Recreation 224
Direct and Indirect Effects under Alternative 1 and Alternative 3 225
Economics 225
Alternative 1 225
Alternative 2 226
Alternative 3 226

Cultural Resources 227

Element 2. The degree to which the proposed action affects public health or safety (40 CFR 1508.27(b)(2)). 227

Alternative 1 (Proposed Action) and Alternative 3 (Non-Commercial Funding) 227

Alternative 2 (No Action) 229

Element 3. Unique characteristics of the geographic area, such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas (40 CFR 1508.27(b)(3)). 229

Experimental Forest 229

Wetlands and Special Aquatic Features 230

Wild and Scenic Rivers 230

Element 4. The degree to which the effects on the quality of the human environment are likely to be highly controversial (40 CFR 1508.27(b)(4)). 231

Element 5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks (40 CFR 1508.27 (b)(5)). 231

Element 6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration (40 CFR 1508.27 (b)(6)). 231

Element 7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27 (b)(7)). 231

Forest Vegetation 233

Effects of Past Actions on Forest Stands 234

Effects of Present Actions on Forest Stands 235

Effects of Reasonably Foreseeable Future Actions on Forest Stands 235

Summary of Effects of Past, Present, and Future Actions on Forest Stands 235

Cumulative Effects under Alternative 1 236

Cumulative Effects under Alternative 2 236

Cumulative Effects under Alternative 3 236

Fire and Fuels 237

Effects of Past Actions or Events on Fire Behavior 237

Effects of Present Actions on Fire Behavior 238

Effects of Reasonably Foreseeable Future Actions on Fire Behavior 238

Summary of Effects of Past, Present, and Future Actions on Landscape Fire Behavior 239

Cumulative Effects under Alternative 1 239

Cumulative Effects under Alternative 2 239

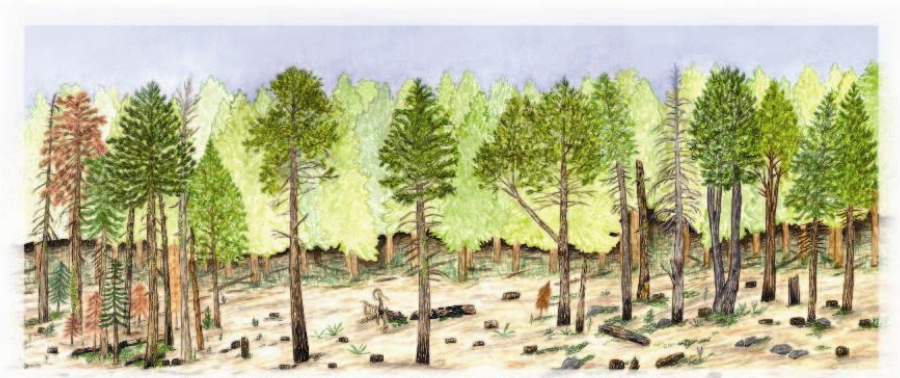
Cumulative Effects under Alternative 3 239
Soil Productivity 240
Hydrology 241
Methodology 241
Cumulative Risk Assessment 242
Wildlife 244
Cumulative Effects Common to All Species 244
Species Specific Cumulative Effects 251
Aquatic Wildlife 261
Past and Present Cumulative Effects 262
Cumulative Effects Future 263
Species Specific Cumulative Effects 264
Plants 267
Past and Ongoing Cumulative Effects 267
Cumulative Effects in the Foreseeable Future 268
Summary of Cumulative Effects 268
Air Quality 269
Cumulative Effects of Alternative 1 269
Cumulative Effects of Alternative 2 269
Cumulative Effects of Alternative 3 269
Recreation 270
Economics 270
Cultural Resources 270
Element 8. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources (40 CFR 1508.27 (b)(8)). 271
Element 9. The degree to which the action may adversely affect an endangered or threatened species or its critical habitat (40 CFR 1508.27 (b)(9)). 272
California Wolverine 272
Lahontan Cutthroat Trout 273
Sierra Nevada Yellow-Legged Frog (Sierra Nevada Dps) 273
Element 10. Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protections of the environment (40 CFR 1508.27 (b)(10)). 274

National Forest Management Act 274
Non-Significant Forest Plan Amendment 275
Vegetation Management Requirements 278
Sensitive Species 281
Migratory Birds 282
Wild and Scenic Rivers 283
National Historic Preservation Act 284
Clean Water Act 284
Chapter 4: Agencies and Persons Consulted 286
Project Scoping 286
List of Preparers 289
Chapter 5: Documents Incorporated by Reference, Acronyms Used and Literature Cited 290
Documents Incorporated by Reference 290
Acronyms Used 290
Literature Cited 292

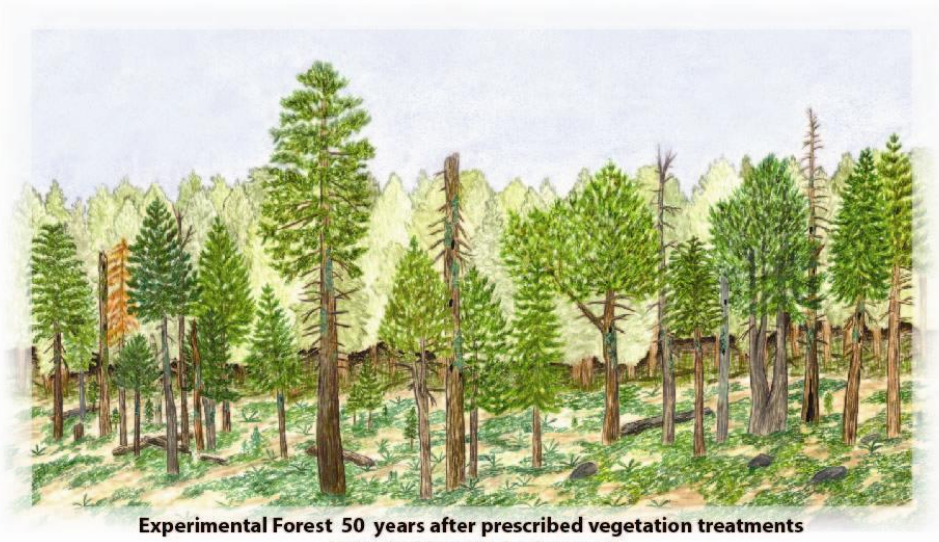
APPENDICES

Appendix A – Standard Management Requirements (SMRs)
Appendix B – Project Maps
Appendix C – Incremental Changes to the Proposed Action
Appendix D – Riparian Conservation Objectives Analysis
Appendix E – Public Scoping Summary

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



Experimental Forest 1 year after prescribed vegetation treatments
Untreated forest in background



Experimental Forest 50 years after prescribed vegetation treatments
Untreated forest in background

© 2012 Stephanie Rozzo, www.stephanierozzo.com

The graphic above is an artist's portrayal of the Sagehen Experimental Forest 1-year post-treatment and 50-years later with untreated forest in the background. Used by permission.

Chapter 1: Purpose, Need and Proposed Action

Introduction

Planning for the proposed Sagehen Project has been a unique undertaking, combining collaboration, science, and forest management in an interactive and novel way. The proposal put forth in this document is the result of an extensive collaborative effort to design an integrated, innovative approach for applying the most recent science to enhance marten habitat, restore forest stand ecological conditions, and manage fire and fuels on national forest lands within the Sagehen Experimental Forest and adjacent Tahoe National Forest. This collaborative effort has included countless hours of fieldwork, analyses, meetings, and document reviews by all involved. The extensive efforts by all stakeholders to work hard and work together have resulted in the Sagehen Project proposal presented in this document.

Most of the proposed Sagehen Project is located within the Sagehen Experimental Forest, which is under the management and direction of a partnership between the Forest Service's Pacific Southwest Research Station (PSW) and the Tahoe National Forest (TNF), in strong collaboration with the University of California (UC) at Berkeley, which manages the Sagehen Creek Field Station in the center of the Basin under a Special Use Authorization. Experimental forests and ranges are intended to be living laboratories where Forest Service scientists and collaborators conduct research and demonstrate research results through experimental approaches that examine various land management and conservation strategies. These lands offer one of the few opportunities to conduct manipulative, innovative research that will produce scientific knowledge required for the stewardship of the Nation's natural resources.

The Sagehen Basin has been a managed forest for many decades. The contemporary condition of the forest in this area is a result of past forest management practices that are typical of conditions found throughout much of the Sierra Nevada. As such, the Sagehen Experimental Forest, with the wealth of scientific data that has been generated by researchers over the past several decades, provides rich opportunities for examining key relationships between stand density, risk of drought-related stress and mortality, and forest resiliency to disturbance.

Experimental forests and ranges are also some of the few places where ecological research can be maintained over the long term. These areas are particularly important to study ecological processes that can only be revealed over long time periods. For example, climate change in recent decades and anticipated changes in the coming decades is expected to result in shifts in the precipitation regime for the Sierra Nevada Range. Snow pack, total precipitation, and the ratio of rain to snow are all expected to shift, resulting in possible greater moisture stress for vegetation during the summer drought period. Competition for available soil moisture will likely increase, particularly among the smaller trees that are now typically found in the Basin's dense stands. Such ecological processes and conditions present a variety of management and concurrent research challenges and that can be addressed in the Sagehen Experimental Forest.

Background of the Sagehen Basin

The Sagehen Basin is an approximate 9,000 acre watershed at the headwaters of Sagehen Creek, a tributary of the Little Truckee River, just on the east side of the Sierra Nevada Range. The Basin lies about 10 miles north of Truckee, California, on the west side of Highway 89. The Sagehen Basin and project area vicinity are depicted in Figure 1 below.

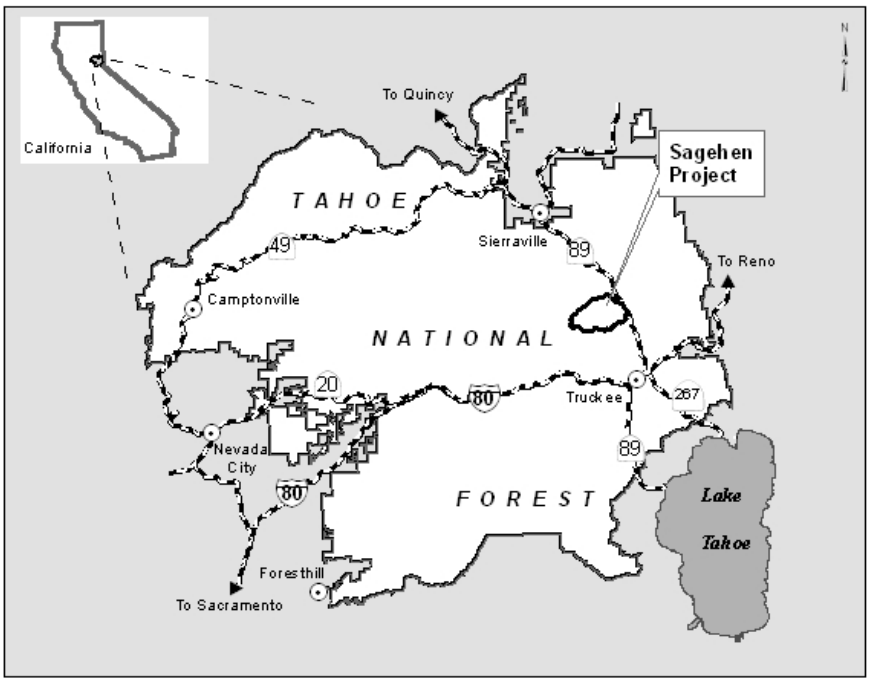


Figure 1. Project Vicinity Map

UC Berkeley has operated the Sagehen Creek Field Station, in the center of Sagehen Basin, since 1951. As a result of the long history of research in the Basin and the ecological diversity there, in November 2005 most of the area was designated an Experimental Forest, with the exception of two private timber company holdings in the southwest area of the Basin and a small remainder in National Forest System (NFS) lands of the Truckee Ranger District, TNF. The Sagehen Basin has hosted hundreds of scientific studies over the last 60 years. The earliest studies were begun by P.R. Needham and A. Starker Leopold with groundbreaking fisheries and wildlife studies. The Field Station was incorporated into the UC Natural Reserve System in 2004. The Sagehen Creek Field Station has accumulated massive amounts of data, which contributes to its value for research. For example, daily weather records date back to 1953 for a weather station established near the main Field Station. Snow telemetry (SNOTEL) records dating from 1978 are also available. In addition, the United States Geological Survey (USGS) has measured stream flow since 1953 and water quality since 1968. Water temperature is measured in several sites along Sagehen Creek and its tributaries. Groundwater depth and temperature are also measured. Other

routinely collected data include daily satellite imagery, seismic activity, and transects of tree sap flow data.

Numerous fauna and flora studies have been conducted, many of which help to inform management strategies for the Basin and the Sierra Nevada Range. The biodiversity in the Basin is high with a total of 686 plant and 212 vertebrate species documented to occur there. There is a very diverse riparian zone associated with the perennially-flowing Sagehen Creek, which includes meadows, fens and a headwater area. The fens in the Sagehen Experimental Forest are well-known for their scientific value and the largest, Mason Fen, has been the subject of research since 1957 and is a designated Special Interest Area. Sagehen Creek has been recommended for National Wild and Scenic River designation (*Record of Decision for Eight Eastside Rivers Wild and Scenic River Study Report and FEIS*, 1999) because of its ecosystem values in the form of fens, unique plants, special geologic formations that support the fens, unique water chemistry that supports rare caddis flies, an assemblage of native fisheries, unique wildlife values, and historical logging values eligible to the National Register of Historic Places. Many studies have been conducted on macroinvertebrates, many of which were discovered and taxonomically defined from specimens collected in springs within the Basin. Long running and repeated studies include native fisheries and introduced trout research, songbird and cavity nesting bird monitoring in relation to areas unburned and burned in wildfires, small mammal/rodent trapping and monitoring associated with the Calhoun Lines that ran approximately 30 years, and studies on beaver populations that began in the 1960s, just to name a few. In addition to the broad set of past and ongoing research projects, an expanding network of data collection instrumentation continues. This network includes a National Atmospheric Deposition Network (NADP) site, 11 meteorological towers ranging from 20 feet to 120 feet in height, a wireless network that allows the movement of data, several transects of shallow and mid-depth ground water wells and wireless monitoring cameras, stream gauging and stage height recording, eddy covariance (eddy flux), and soil and atmospheric mercury deposition. These installations will continue to expand over time allowing for the collection and archiving of a broad range of long term data sets.

Since 1978, the Sagehen Basin has been host to a number of crucial research studies on marten distribution, habitat use and preferences, and prey selection. Some notable theses and dissertations completed on marten in or adjacent to the Sagehen Basin include: An *Ecological Study of the Marten in the Tahoe National Forest, California* (Simon, 1980), *Food Habits, Activity Patterns and Ectoparasites of the Pine Marten at Sagehen Creek, California* (Zielinski, 1981), *Pine Marten Habitat Preferences at Sagehen Creek, California* (Spencer, 1981), *The Ecology of the Pine Marten (Martes americana) at Sagehen Creek, California* (Martin, 1987), and *Pacific marten Distributions over a 28 Year Period: Relationships with Landscape Change in Sagehen Creek Experimental Forest, California, USA* (Moriarty, 2009). Many other subsequent publications were produced based on data presented in the above theses and dissertations.

As in many places of the Sierra Nevada, the Sagehen Basin has also been subjected to numerous disturbances over time. For example, sheep, and occasionally cattle, actively grazed the area from the Gold Rush era, through the early 1990s. The Sagehen Basin was removed from the TNF grazing program in 2008. In addition, portions of the Basin have been subject to high-severity fire in the past, such as the

1928 Independence Fire, and most notably the Donner Ridge Fire that occurred in the fall of 1960 which burned approximately ⅓ of the Basin (2,500+ acres).

Native American use of the Sagehen Basin was transitory in nature. It was only used intermittently for hunting and gathering, with primary use areas and camp sites further down Sagehen Creek in the Stampede Valley area (now covered by Stampede Reservoir). Cultural resource inventories have located very few prehistoric sites in the Basin, primarily consisting of sparse lithic scatters of local basalt toolstone.

The Sagehen Basin was heavily logged from the 1870s through the 1930s. From the 1870s through 1890s, the Banner Mill, a sawmill, was located within the Basin. During this time, sawtimber was cut and milled within the Basin, after which contractors came in and removed most of the remaining trees in cut areas for cordwood. After the Banner Mill closed, another private timber company, the Sierra Nevada Wood and Lumber Company, began removing sawtimber from the remaining sections in the Basin. A mainline railroad grade was pushed north through the Sagehen Basin. Harvesting by this company extended up in elevation to much of the red fir sawtimber in Section 10, Township 18N, Range 15E. By 1931, the Company had begun to harvest the sawtimber within the Basin with early tractor based logging systems. From the 1890s through 1936, most if not all of the remaining saw (merchantable) timber was removed from the Basin. What remained was a scattering of second growth trees that grew in after the 1870s-1890s logging and the non-merchantable trees left after sawtimber removal from the 1890s-1936 (Knowles, 1942, Myrick, 1992, Wilson, 1992). The Forest Service purchased the land in 1936. Trees remaining in 1936 became some of the legacy trees seen in the Basin today.

Since 1936, there have been some logging and salvage operations conducted by the Forest Service, most notably post-fire salvage logging in the 1960s, the Golden Timber Sale in 1988, the Sagehen Salvage Sale in 1990, and the Sagehen and Spring Chicken Fuel Breaks in 1998 and 2002 respectively. The Golden Timber Sale was primarily a select and seed tree harvest over approximately 368 acres and resulted in the removal of approximately 34, 12-35 inch diameter at breast height (dbh) trees per acre. Partially overlapping this, the Sagehen and Spring Chicken Fuel Breaks (524 acres total) removed approximately 200, 3-29.9 inch dbh trees per acre, although the vast majority of trees removed were less than 15 inches dbh. The Sagehen Salvage Sale also partially overlapped the Golden and fuel break sales and it encompassed a total of 2,433 acres, although it is estimated that approximately 800 acres were directly affected with the removal of 1-5 greater than 15 inch dbh dead and dying trees per acre. It is estimated that, outside of stand replacing wildfire areas, approximately 1,700 acres have had some sort of timber harvest occur since the 1980s. This amounts to 28% of the NFS lands in the Sagehen Project Area, outside of stand replacing wildfire areas.

Even with these activities and disturbances, there are portions of the Basin that have not seen active timber management since the Forest Service acquired the land. Fires have been actively suppressed, and dense forest conditions have developed in many places. It is estimated that approximately 4,500 acres have not been actively managed since Forest Service acquisition in 1936.

Need for the Sagehen Project

This section describes why the Forest Service is proposing to take actions now in the Sagehen Basin to:

- reduce hazardous fuel loadings and modify landscape-scale wildland fire behavior;
- maintain and enhance habitat for the marten and other wildlife species associated with late seral forest habitat;
- create heterogeneous forest stand conditions that would be expected to develop under an active fire regime;
- enhance the ecological role of fire; and
- restore declining aspen stands within unit boundaries.

Reducing hazardous fuel loadings and modifying landscape-scale wildland fire behavior

A large wildfire in the Sagehen Basin would likely have severe adverse effects on natural and cultural resources as well as human property and life. Large, uncharacteristically severe wildfires have occurred in and around the Sagehen Basin in the past, most notably the 1960 Donner Ridge Fire, which burned a total of approximately 44,000 acres under high fire intensities, including the southeastern one-third of the Basin. In addition, the 1928 Independence Fire burned approximately 3,900 acres along the northwestern area of the Basin. The majority of the Sagehen Basin has not burned for decades, resulting in high fuel loadings throughout the area. The southeastern portion of the Basin is extensively occupied by post-fire plantations, which are now nearly 50 years old, while much of the remaining area is occupied by densely stocked, primarily second growth conifer forest stands, which emerged after logging done from the 1870s through the 1930s, followed by decades of fire exclusion. The accumulation of forest fuels over time has created the potential for a large, severe wildland fire in the Sagehen Basin.

There is substantial risk that a wildfire could start in the more populated areas located to the south of the Sagehen Basin during a period of low fuel moistures and be driven into the Basin by winds from the south or southwest. Under such a scenario, the fire entering the Basin would likely be characterized by extreme fire behavior, with long flame lengths and high rates of spread. Such a fire would be expected to spread in a manner similar to the historic Donner Ridge Fire or other more recent large fires in the Truckee/Tahoe area. There is also the possibility of a fuel-driven wildfire from the south and southwest in which fire would move through the even-aged plantations in the southeastern portion of the Basin. The high vegetation densities in these plantations, combined with the short distance from the ground to the live crowns of the trees, would cause the fire to spread rapidly. A secondary threat is a wildfire starting along Highway 89, which could be driven into the Basin by winds from the north/northeast.

A rapidly spreading wildfire in the Sagehen Basin would adversely affect numerous ecological values, including high quality late seral habitat for the marten, California spotted owl, and northern goshawk as well as unique habitats, including aspen stands and fens. A severe wildland fire could have substantial adverse effects on riparian habitats and water quality in Sagehen Creek and its tributaries, the waters of which enter the Little Truckee and Truckee Rivers. The State of California has listed the Truckee River as

being “water quality limited” under Section 303 (d) of the Clean Water Act, and Sagehen Creek has been recommended for designation as a Scenic River under the Wild and Scenic River Act (USDA, 1999). Finally, the Sagehen Basin is eligible for listing as a National Historic District; a severe wildland fire would likely adversely affect the numerous cultural resources present in the Basin.

Maintaining and enhancing habitat for the marten and other wildlife species associated with late seral forest habitat

The Sagehen Basin currently provides habitat for Forest Service designated sensitive species associated with late seral forest conditions, most notably the Pacific marten (*Martes americana*), northern goshawk (*Accipiter gentilis*), and California spotted owl (*Strix occidentalis occidentalis*) The Basin contains one spotted owl and five goshawk designated protected activity centers (PACs) as well as one designated spotted owl home range core area (HRCA) associated with the spotted owl PAC. These areas provide for suitable nesting and foraging habitat for these species.

While there are no formally designated marten use areas as there are for goshawk and spotted owls, the Sagehen Basin’s well documented history of marten research points to habitats and areas within the Basin that are particularly important to martens. These areas can be adversely affected by management activities, especially if marten needs are not considered in the design of the activities. In addition, the most recent study (Moriarty, 2009) documents a dramatic decrease in marten occurrence as compared to results from earlier studies. This information accentuates the need to maintain and enhance marten habitat within the Basin over both the short and long term. Where marten habitat falls within proposed treatment areas, the need to specifically consider marten requirements and habitat needs in the development of potential project prescriptions becomes critical.

Because high value marten habitat (defined below in Table 1) is representative of habitat components and conditions that are important to other late seral species such as goshawk and spotted owl, maintaining and enhancing conditions for marten, along with protecting PACs, would also maintain and enhance habitat conditions for goshawks and spotted owls.

A landscape configuration of areas of high value habitats (such as reproductive, resting, foraging, and nesting habitats), combined with other habitat types (such as more open areas that may provide habitat for prey species), is critical in maintaining and enhancing habitat conditions capable of supporting martens and other wildlife species that rely on late seral habitats. Action is needed to maintain existing high quality habitats by reducing the potential for uncharacteristically severe wildfire effects while enhancing both stand and landscape habitat conditions by (1) retaining and/or enhancing the Basin’s high value habitats for marten, goshawk, and spotted owl; (2) retaining and recruiting large trees and crown cover; (3) retaining and recruiting areas called dense cover areas (DCAs) that currently have dense, multilayered tree and vegetation conditions, and areas that provide early seral conditions suitable for prey species; (4) maintaining or restoring connectivity across or around areas of unsuitable habitat; (5) retaining and recruiting trees with decay and/or “defect” structures to support cavity development or platforms for denning, nesting, and resting sites; and (6) retaining and recruiting large and small dead wood features such as snags, high stumps/short snags, and down logs in various configurations.

Creating heterogeneous forest stand conditions that would be expected to develop under an active fire regime

Past large uncharacteristically severe wildfires (specifically the Donner Ridge and Independence), combined with reforestation efforts 50 years ago, have resulted in the extensive plantations, consisting mostly of Jeffrey pine, that currently occupy the southeastern, northeastern, and northwestern areas of the Sagehen Basin. Dense second growth conifer stands occupy much of the remainder of the Basin and fire has been excluded from these natural stands for decades. Past fires, reforestation, timber harvesting, and fire exclusion have combined to create today's simplified, relatively homogenous structure of the plantations and many of the Basin's forest stands.

The structure and tree species composition of the plantations and many of the Basin's forest stands have made them vulnerable to a host of mortality factors, including drought stress, bark beetle outbreaks, disease, and the over-arching ramifications of climate change. Excessive tree mortality can have significant and long-term effects on forest structure and composition, and these conditions can exacerbate the threat of severe fire. Action is needed to develop forest stands that can be more resilient to this array of threats. Enhancing forest heterogeneity at both the stand- and landscape-scale; reducing stand densities in certain locations; and modifying tree species composition, for example, favoring more fire resilient pines on south facing slopes, could address these potential sources of mortality. Reducing stand densities would result in less competition for soil moisture resources and light, which would help accelerate the development of stands comprised of larger trees. By creating a more heterogeneous landscape, remaining trees and stands would be better able to cope with drought stress, insect infestation, and disease outbreaks. Climate change is anticipated to aggravate these stressors; hence, action is needed to enable stands in the Sagehen Basin to be more resilient under expected future conditions.

Enhancing the ecological role of fire

Fire plays a pivotal role in reshaping and maintaining forest ecosystems; however, fire has been excluded from the Sagehen Basin for many decades. Action is needed to jumpstart ecosystem processes that have been stalled by accumulating surface fuels and the absence of frequent burning (North 2006). Fire adapted ecosystems, like the Sagehen Basin, need fire as an active ecosystem process in order to improve or maintain fire resilient attributes. Low intensity surface fire would achieve many objectives intended for fire resilient forests, such as reducing surface and ladder fuels, increasing canopy base height (pruning lower limbs), and increasing the proportion of fire resistant tree species. A long-term goal is to return more frequent, low intensity fire to this Basin. This cannot be achieved without some initial management action to reduce the excessive fuel loading that currently exists.

Restoring declining aspen stands within unit boundaries

Due to fire exclusion, some aspen stands in the Sagehen Basin have been overtopped by conifers. Thus these stands have a higher percentage of conifers compared to aspen, and have very little regeneration of aspens due to over-shading. Aspen habitat is particularly important for biological diversity and is

limited across the landscape. Actions to restore aspen stands within unit boundaries would help to enhance and perpetuate these highly diverse habitats over the long term.

Purpose of the Sagehen Project

The primary purpose of an Experimental Forest is to provide opportunities for research to address a wide variety of ecological questions in forest settings including response of forest systems to land management practices. A carefully designed research project, funded by a Joint Fire Science Program grant, was initiated by researchers from UC Berkeley in 2007 to examine the effects of a pattern of strategically placed area treatments (SPLATs) laid out across the Sagehen Basin. The concept of establishing a pattern of SPLATs across a landscape in order to modify landscape-level wildfire behavior has been developed through extensive computer simulations, and a number of scientific publications describe the prospects that this approach offers. However, little field testing of this concept has been executed. This study was designed to investigate how a SPLAT approach performs in the field, using carefully quantified conditions of fuels, canopy cover, and tree size distribution with field data and airborne Light Detection and Ranging (LiDAR) data (can be thought of as laser radar). A key objective in meeting the need for action is to develop a landscape pattern of fuels treatments that would implement the conceptual fuels treatment strategy delineated in the UC Berkeley study. Forest management in the Sagehen Basin presents an ideal opportunity to field test, based on extensive pre- and post-treatment field data and more advanced computer modeling, the likely effects of such fuel treatments. Implementation of the treatments in the field would take this research a large step forward by allowing researchers to examine how an actual treatment regime performs.

Notwithstanding the overarching SPLAT design, the setting of a vegetation and fuels management project within the Sagehen Experimental Forest further presents an unprecedented opportunity to test innovative ideas related to forest management, particularly in eastside forest stands. Another key objective for this project is to design, test, and apply vegetation and fuels management approaches that are congruent with principles put forth in *An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests* (North et al. 2009), also referred to as General Technical Report (GTR) 220. This Report presents a comprehensive overview of the recent scientific literature regarding mixed conifer stands in the Sierra Nevada and its bearing on forest management approaches. The Report's recommendations are aimed at enhancing forest resiliency, increasing stand and landscape scale heterogeneity, restoring the ecological role of fire to the landscape, and maintaining habitat for sensitive wildlife species in Sierra Nevada mixed conifer forests. Specifically for the Sagehen Project, objectives for sensitive species management focused on providing high quality marten habitat; providing protection for northern goshawk and California spotted owl protected activity centers (PACs); retaining and recruiting large trees and crown cover; maintaining and recruiting areas that currently have dense, multilayered tree and vegetation conditions, and areas that can represent early seral conditions suitable for prey species; maintaining and recruiting trees with structure to support cavity development or platforms for denning, nesting, and resting sites; and maintaining and recruiting large dead wood features such as snags and down logs.

Proposed Action

Note to reader: As a response to comments raised, the proposed action has been slightly modified: Unit 39 as described in the preliminary EA has been dropped from the proposed action. The acreages displayed in the section below and in Chapter 2 reflect the removal of this unit. In addition, effects of dropping Unit 39 on goshawk habitat in the NE Sagehen goshawk protected activity center (PAC) are addressed in the Biological Evaluation and summarized in Chapter 3 of this EA. Given that dropping Unit 39 results in such a small change in the overall proposed treatment acreage (a decrease of 1.2 percent), other resource analyses presented in Chapter 3 continue to be based on the original assumption that Unit 39 would be underburned only, as initially proposed. Due to the small size of this unit and the original proposal to only underburn this unit, removal of Unit 39 will not measurably change the effects analyses detailed in the Project's specialist reports and summarized in Chapter 3 of this document.

In response to the purpose and need for action the Responsible Officials have proposed to carry out a variety of manual, mechanical and prescribed fire vegetation treatments on 2,621 acres of National Forest System lands within the 9,478 acre project area. The proposed action was developed drawing from an extensive collaborative process with project stakeholders. The collaborative process is described in more detail later in this section of the EA.

The proposed action consists of the following primary vegetation treatments:

- 1,213 acres of mechanical thinning and piling,
- 844 acres of mechanical thinning and mastication,
- 347 acres of hand thinning and piling,
- 132 acres of mastication only,
- 84 acres of underburn only, and
- 1 acre of mechanical thinning only.

Follow-up vegetation treatments include pile burning and underburning in most units as appropriate as is displayed on Table 2.1 in Chapter 2.

The Sagehen project area is sub-divided into 24 treatment units non-sequentially numbered 33 through 282. Each treatment unit is further sub-divided among several emphasis areas that remain constant throughout the project. Development of the emphasis areas is a key aspect of the proposed action. Emphasis areas 1-7 all share the common goals of 1) enhancing marten habitat, 2) forest stand level ecological restoration, and 3) fuels reduction; the difference between treatments in these emphasis areas is the priority given each above goal. Emphasis area 8 has a unique project goal. Each emphasis area is briefly described below:

Emphasis Area 1: This emphasis area contains high quality marten habitat and the primary management goals are the conservation and restoration of marten habitat values in both the near and long-term. Secondary and tertiary goals include ecological restoration and fuels

reduction respectively. Emphasis Area 1 includes 453 acres or 17% of the total treatment unit acres.

Emphasis Area 2: This emphasis area includes drainage bottoms with high quality marten habitat and consistent presence of lodgepole pines with dbh greater than 11 inches and 40% crown cover. The primary goal is to manage for marten use, especially foraging habitat. It is also important to manage for stand level ecological restoration and a heterogeneous forest followed by fuels reduction. Emphasis Area 2 includes 103 acres or 4% of the total treatment unit acres.

Emphasis Area 3: This emphasis area was eliminated and distributed between Emphasis Areas 1 and 2. See discussion of emphasis areas in Chapter 2 for rationale.

Emphasis Area 4: This emphasis area includes drainage bottoms that do not currently support high quality marten habitat. Emphasis Area 4 is more variable in moisture conditions, vegetation types, position on slope and aspect. The primary goal of emphasis area 4 is the same as for emphasis area 2: to manage for marten foraging habitat, and also for stand level ecological restoration and a heterogeneous forest followed by fuels reduction. Emphasis Area 4 includes 173 acres or 7% of the total treatment unit acres.

Emphasis Area 5: This emphasis area represents north facing slopes that are currently not high quality marten habitat. The primary goal in this emphasis area is to work towards stand level ecological restoration, followed by marten habitat enhancement and fuels reduction. Emphasis Area 5 is the largest of the emphasis areas and includes 996 acres or 38% of the total treatment unit acres.

Emphasis Area 6: This emphasis area represents south facing slopes with vegetation and soil types not considered high value marten habitat. The primary goal in emphasis area 6 is fuels reduction, followed by producing heterogeneous forest stand conditions and then managing for marten habitat. Emphasis Area 6 is the second largest of the emphasis areas and includes 740 acres or 28% of the total treatment unit acres.

Emphasis Area 7: This emphasis area represents ridge tops with vegetation and soil types not considered high value marten habitat. The management goals for Emphasis Areas 6 and 7 are the same: 1) Fuels reduction, 2) heterogeneous forest stands, and 3) marten habitat. Emphasis Area 7 includes 150 acres or 6% of the total treatment unit acres.

Emphasis Area 8: The only goal in this emphasis area is stand level ecological restoration of aspen stands; however, this goal is solely focused on a small forest stand scale, and does not represent all aspen stands within the project area. Emphasis Area 8 includes 6 acres or less than 1% of the total treatment unit acres.

A detailed description of the proposed action, treatment methods, design features and management requirements is presented in Chapter 2. A map of the proposed action is included in Appendix B.

History of the Proposed Action

The Truckee Ranger District staff recognized the risk of another large wildfire and as a result began to actively pursue options to reduce the risk in 2003. The "Sagehen Project" began with the overall goal of reducing the potential of uncharacteristically severe wildfire effects through the implementation of fuels reduction treatments and management direction as laid out in the *Sierra Nevada Forest Plan Amendment Record of Decision* (SNFPA ROD 2004). The initial strategy proposed to reduce the risk of large scale wildfire was to designate SPLATs. SPLATs are intended to slow the spread and reduce the size and severity of a wildfire across a planning landscape as well as to modify fire behavior within the treatment areas. The assumption with SPLATs is that, given an effective treatment area shape and pattern, only a portion of the landscape needs to be treated and maintained to produce desired modifications in wildfire behavior over the entire landscape.

To designate initial SPLATs, the Truckee Ranger District worked closely with the UC Berkeley Sagehen Creek Field Station beginning in 2004. The first draft of designating SPLATs involved drawing treatment areas, each averaging 100-300 acres in size, in a manner approximating a theoretical treatment pattern described in Finney (2001). This initial effort was done based solely on topography and natural or man-made breaks in the continuity of vegetation; there was no consideration of land allocations or sensitive resources. Then, as laid out in the SNFPA ROD (2004), potential treatment areas (SPLATs) were modified based on direction to avoid sensitive areas such as California spotted owl and northern goshawk Protected Activity Centers (PACs) to the greatest extent possible. Concurrently with this modification, fire modeling, using the models *FlamMap* and *FARSITE*, was conducted to assess preliminary effectiveness. Further modifications were made 1) to eliminate areas of low fire risk such as high elevation areas, 2) to generally avoid sensitive plant or aquatic resources and cultural resource sites, and 3) to refine SPLAT boundaries in areas where modeling showed a need for treatment based on projected fire behavior. In conjunction with this, opportunities to improve forest health and resiliency were also considered, typically tied in with reducing stand densities. By 2007, the final proposed SPLAT boundaries focused on treating areas that showed high fire intensities and provided opportunities to reduce stand densities, while avoiding many sensitive areas per direction in the SNFPA ROD (2004).

Scientists from the University of California (John Battles and Scott Stephens) developed a research approach and collected vegetation and fuels data to examine the effects of SPLATs. From 2004-2008, the focus of the Project planning was to design fuels and forest health treatments within SPLAT treatment units. Upon the designation of the Sagehen Experimental Forest, the Truckee Ranger District also began to work closely with PSW to incorporate experimental forest objectives into project planning.

Early in 2010, the Truckee Ranger District and PSW agreed to take a step back from the internal project planning that had been done to date. An expanded collaborative planning process was begun to engage all interested parties and stakeholders (public, private, and agency) to thoroughly examine the issues that pertain to fuels reduction management in light of new information in GTR 220, as well as information put forth in a master's thesis titled *American Marten Distributions over a 28 Year Period: Relationships with Landscape Change in Sagehen Creek Experimental Forest, California, USA* (Moriarty, 2009). The thesis documented surveys and inventories to determine American marten distributions within the Sagehen Basin, and how those distributions changed as compared to similar studies in the

1980s. Management implications were put forth to preserve and restore habitat and to increase the likelihood of marten persistence within the Basin. A grant was obtained from the Sierra Nevada Conservancy to support an independent facilitator and the collaborative effort was launched in May of 2010.

How the Proposed Action was Developed through Collaboration

Collaborative Process

In May 2010, a collaborative planning process was begun to engage all interested parties and stakeholders (public, private, and agency) to examine issues that pertain to fuels reduction management and to consider new information. Approximately 140 potentially interested and affected parties were initially invited to participate in the process. Since May 2010, approximately 20-60 people (average of 25), representing local city, county, and state agencies, other federal agencies, environmental groups, private companies, universities and research, Forest Service research, and interested citizens have routinely and actively been participants in the collaborative process.

One constraint was placed on the collaborative effort: proposed activities would be limited to the areas covered by the prior (2004-2008) planning effort and data collection areas, where a suite of survey activities had already been completed. The primary reason for this limitation was to avoid the need for and costs of additional surveys and inventories. Opening up the planning process to the entire Sagehen Basin would have added significant costs and time to the process and the Forest Service (PSW and Truckee Ranger District) did not have the funds or timelines that would allow additional surveys at that time. With that one caveat, the Collaborative Planning process began to explore all the issues that the collective body considered meaningful and necessary to address as part of a forest or fuels management project.

The Collaborative Planning process for the Sagehen Project was intended to generate comprehensive stakeholder participation and input. This was used in defining approaches for implementing vegetation and fuels management and ecological restoration activities and methods. In general, the goal of a collaborative process is to reach a decision everyone can accept. In this case, the end goal was to use input, review, and ideas from the collaborative group to generate a Proposed Action and Purpose and Need (PA/PN) document that could be used to begin the National Environmental Policy Act (NEPA) process. Through the collaborative process, PSW and the Truckee Ranger District wanted to provide ample opportunity for satisfying the concerns of involved parties. By discussing and exploring issues in advance of any official NEPA action, the group could collectively reveal and deal with many issues prior to crafting and putting forth a PA/PN.

Steps Used to Craft the Proposal

Collaboration took place primarily through a series of meetings, with an independent facilitator, with information shared through email, web postings, conference calls, and live web meetings. The initial stages were designed to inform stakeholders of the existing conditions and natural resource data that existed regarding the Sagehen Basin and to identify any and all questions, concerns, and issues stakeholders had in relation to a proposed project in the area. Less complex issues and questions were addressed during the meetings and/or through modifications or additions to the proposal. Committees

or subgroups of particularly interested stakeholders were formed to address the more complex and specific questions and issues. Four issues drove much of the proposed action development. One general issue was stakeholders were unsure of what a treatment would look like that incorporated concepts from the GTR 220. The other main issues were concepts of ecological restoration and increased forest resiliency to change, habitat protection and enhancement for the Pacific marten, and how proposed treatments affect fire behavior.

GTR 220 Treatment Example – Sagehen Test Plots

To address the question of what a GTR 220 project looked like, two test plots of approximately three acres each were selected, one in the northeast portion and one in the southwest portion of the Basin. The test plots were designed to be representative of the larger project landscape. Each plot was inventoried, marked (in conjunction with the GTR 220 authors), harvested, and in the case of one plot, underburned during the summer/fall of 2010. Post treatment, the plots were re-inventoried to provide metrics of sizes, species, and numbers of trees removed, basal area removed and retained, and before and after canopy cover. Post treatment photo point monitoring was also conducted. The plots helped to illustrate and test the prescriptions and methods described below under the *Prescriptions and Treatments* section. Specifically the plots demonstrated variable thinning, legacy tree treatment, suppressed cut, dense cover area (DCA), and early seral opening (ESO) prescriptions. See below for more detail.

The test plots proved to be very important to the larger collaborative process. The collaborative group was able to view the resulting stand composition and structure as well as two small adjacent areas that were sample marked to represent a before treatment condition. Data collected proved very effective in communicating the anticipated outcomes of treatments and helped further refine prescriptions for the larger Sagehen Project Area. Lessons learned helped to define operating procedures and to fine tune expectations on the logistics of implementation. The test plots provided a visual confirmation of the concepts expressed in GTR 220. Overall they helped provide common understanding of the concepts, opportunities, and challenges in using GTR 220.

Ecological Restoration and Habitat Protection/Enhancement for the Marten

One particular subgroup was formed to deal specifically with two of the main concerns raised. This subgroup dealt with: (1) how concepts of ecological restoration and increased forest resiliency to change from the GTR 220 could be incorporated into project design while (2) also addressing habitat protection and enhancement for the Pacific marten.

A formal definition of ecological restoration is “The process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions”(USDA Forest Service Manual 2020.5). For the Sagehen Project, the concept of stand level ecological restoration focuses on creating a heterogeneous forest stand that would be representative of a forest stand under a more active fire regime. Therefore, it would be expected that forest stand species mixes, structures, and densities would vary dependent upon topographic variables, such as slope aspect and position.

This subgroup helped to define draft prescriptions and objectives which were brought for review and input to the larger collaborative group at multiple times through the process. In order to do this, the subgroup reviewed all Pacific marten research conducted in the Sagehen Basin. Recommendations, habitat metrics important to marten (such as snag and down log sizes and densities), and habitat definitions were pulled directly from research studies. In particular, Spencer (1981), Martin (1987), and Moriarty (2009) provided a wealth of information that allowed the subgroup to define high quality marten habitat and designate habitat components and metrics important to marten. Table 1 below describes the habitat definitions (Moriarty, 2009, as slightly modified with input from Katie Moriarty and Bill Zielinski) that the subgroup used to identify high and moderate quality marten habitat within the Basin.

Table 1.1: Definitions of High and Moderate Quality Marten Habitat within the Sagehen Basin (Moriarty 2009, modified)

Habitat	Forest Type	Size Class*	Canopy Closure**
High Quality			
	Lodgepole Pine (LPN)	4, 5	M, D
	Montane Riparian (MRI)	5, 6	M, D
	Red Fir (RFR)	4, 5	M, D
	Subalpine Conifer (SCN)	4, 5	M, D
	Sierran Mixed Conifer (SMC) – Fir dominated stands only	5, 6	M, D
	White Fir (WFR)	4, 5, 6	M, D
Moderate Quality			
	Eastside Pine (EPN) – Higher lodgepole pine component only	4, 5, 6	P, M, D
	Eastside Pine (EPN)	5, 6	M, D
	Jeffrey Pine (JPN)	5, 6	M, D
	Lodgepole Pine (LPN)	4, 5	P
	Montane Riparian (MRI)	4	M, D
	Red Fir (RFR)	4, 5	P
	Subalpine Conifer (SCN)	4, 5	P
	Sierran Mixed Conifer (SMC) – Fir dominated stands only	4	M, D
	Sierran Mixed Conifer (SMC) – Pine dominated stands only	5, 6	M, D

** Size class in diameter at breast height (dbh) inches: **4** = 11"-24", **5** = >24", **6** = >24" with multi-layered canopy.*

*** Canopy closure in percent: **P** = 25-39%, **M** = 40-59%, **D** = 60-100%*

One of the key principles in GTR 220, the concept of topographic variability as a determining factor in forest composition and structure, was used in combination with other key sources of spatially explicit information (e.g. locations of high quality marten habitat and vegetation types) to partition the landscape into subunits which were termed as emphasis areas. Objectives were then developed for each emphasis area type. Not all the emphasis areas have equal value (as habitat) or have equal ecological potential (for one kind of forest stand or another based on topography or site condition), or generate equal concern (for fire behavior). A benefit of the emphasis area approach was that it provided a way to deal with issues that some in the collaborative group perceived as mutually exclusive. The perceived problem that fuels could not be reduced while still maintaining habitat for late seral species was addressed by explicitly designating where in the potential treatment areas one objective had a greater priority than the other. For example, ridges and drier south facing slopes are areas that typically experience more severe wildfire effects as compared to north facing mid slopes, whereas typically north

facing mid slopes tend to have more of the preferred habitats for late seral species. By partitioning the landscape, objectives could be specifically tied to existing and potential conditions that explicitly address landscape heterogeneity and/or habitat quality. Based on these objectives, tailored silvicultural and fuels management strategies were crafted to meet the needs for each of the emphasis areas considering the habitat needs of marten, stand level ecological restoration as described in GTR 220, and fuels reduction to effectively modify fire behavior.

How Proposed Treatments Affect Fire Behavior

A Forest Service Enterprise Team was hired to model how proposed treatments might affect post treatment fire behavior. Modified fire behavior combined with increased resiliency would result in less severe wildfire effects. For this treatment strategy to be considered a credible approach, the Forest Service sought evidence that the treatments, addressing multiple objectives, resulted in effective reduction of potential large, uncharacteristically severe wildfire effects. The results of the fire behavior modeling were used in development of the proposed action. The collaboration group reviewed and provided input to the fire behavior modeling.

Decision Framework

Because the Sagehen Project falls within the Sagehen Experimental Forest and upon lands managed by Pacific Southwest Research Station and the Truckee Ranger District, Tahoe National Forest, both the Pacific Southwest Research Station Director and the Tahoe Forest Supervisor have responsibilities for this project and are both responsible officials. The responsible officials will decide to whether to approve the proposed action, an alternative to the proposed action, no action, or a modification of the proposed action.

Forest Plan and Management Direction

Most of the Sagehen Project Area is encompassed within the Sagehen Experimental Forest. A small portion of the area along the northeastern portion of the Project Area lies on the Truckee Ranger District of the Tahoe National Forest. The *Establishment Record for Sagehen Experimental Forest* (November 28, 2005) specifies that management direction for the Sagehen Experimental Forest will follow the *Tahoe National Forest Land and Resource Management Plan* (USDA 1990) as amended by the *Sierra Nevada Forest Plan Amendment* (USDA 2004) (referred to as the Forest Plan) for Management Areas 036 (Sagehen Basin) and 043 (Sagehen Station). Management direction for the portion of the Project Area on the Truckee Ranger District is provided by the Forest Plan.

A wildland urban interface (WUI) defense zone surrounds the immediate vicinity of the Sagehen Creek Field Station, and the defense zone is buffered by a WUI threat zone. Most of the Project Area lies within the old forest emphasis area land allocation, although the eastern portions of treatment units 46, 76, 98, and 100 and all of unit 99 lie within the general forest land allocation.

A portion of Sagehen Creek lies within the project area. Sagehen Creek has been recommended for Wild and Scenic River designation (*Record of Decision for Eight Eastside Rivers Wild and Scenic River Study Report and FEIS*, 1999), and is currently managed under interim management standards as a Scenic River.

Five northern goshawk and one California spotted owl protected activity centers (PACs) as well as one spotted owl home range core area (HRCA) lie within the project area. Selection of Alternative 1, the Proposed Action, by the Responsible Officials, would require a project-level non-significant Forest Plan amendment to allow for vegetation treatments within the Sagehen NE goshawk PAC. For a detailed discussion of the proposed plan amendment see Chapter 3, FONSI Element 10 under the National Forest Management Act, Non-significant Forest Plan Amendment section.

Public Involvement

As discussed above, the proposed action was developed through an extensive collaborative effort with numerous stakeholders. This effort included ten formal collaboration meetings, some of which were field meetings, dozens of informal committee/subgroup meetings, and multiple dozens of emails/contacts regarding requests for feedback, reviews, information sharing, and comment submission. One purpose of this effort was to identify potential issues from all interested parties and to design a project that addressed issues and concerns from the beginning. This effort and all the stakeholders involved provided the basis for the project's mailing lists. The project mailing list is included in Chapter 4. Nine comments were received during the scoping period. A summary of the comments and the Forest Service responses to them are included as Appendix E.

The Sagehen Project proposal has been published on the Tahoe National Forest's quarterly Schedule of Proposed Actions (SOPA) since January, 2005. The proposal was provided to the public, other agencies, and all stakeholders from the collaboration effort for comment during scoping beginning on November 23, 2011. A legal notice of a 30-day scoping period was published in the newspaper of record, *The Union,* Grass Valley, California on November 23, 2011 as well. In addition to provide a notice to the local interests, an additional notice was published in the *Sierra Sun*, Truckee, California on November 23, 2011. In total, the notice for scoping was mailed to 125 potentially interested citizens and agencies, including three notices to the Washoe Tribe of Nevada and California (Washoe Tribe). Scoping comments were accepted and incorporated throughout the entire NEPA process including after the 30-day formal comment period described below.

A notice of the availability of the preliminary EA was mailed to all those who had participated in project planning and/or the collaboration process, expressed interest in the project, or requested notification about the Project. The preliminary EA and all specialist reports were posted to the Tahoe National Forest's website listing of projects. Hard copies of all materials were mailed to one interested stakeholder and to the Washoe Tribe. The legal notice of the 30-day opportunity to comment was published in Grass Valley's *The Union* on March 6, 2013 as well as the Sierra Sun on March 6, 2013. Three letters were received. The response to comments presented in these letters is displayed as an attachment to the Decision Notice/Finding of No Significant Impact for the Sagehen Project.

Issues

Issues have a cause-effect relationship to the actions under consideration. An issue statement describes a specific action and the environmental effect(s) expected to result from that action. Cause-effect statements provide a way to understand and focus on the issues relevant to a particular decision. Issues serve to highlight effects or unintended consequences that may occur from the proposed action and alternatives, giving opportunities during the analysis to reduce adverse effects and compare trade-offs for the decision maker and public to understand. The collaborative effort undertaken in development of the proposed action helped identify key issues early on in the planning process. This facilitated setting the scope of the actions, alternatives, and effects to consider.

Nine comments were received during the formal project scoping period. See Appendix E, "Scoping Comment Summary", for a summary of input received during scoping and discussion related to this input. Complete copies of all the scoping comments received are part of the Sagehen Project record on file with the Tahoe National Forest.

The Responsible Officials reviewed the scoping comments. Much of the input received consisted of either "non-issues", questions and/or general comments about the proposal; however, four key issues have been identified by the Responsible Officials as a result of public scoping, internal agency scoping and the Sagehen Project collaborative planning effort. The key issues are detailed below.

Issue 1. High quality Pacific marten habitat has been identified within the Sagehen Project Area, and a recent study (Moriarty, 2009, Moriarty, 2011) documents a dramatic decrease in marten occurrence as compared to results from earlier studies. Pacific martens and their habitat could be adversely affected by implementation of proposed silvicultural and fuels prescriptions.

Issue 2. Five northern goshawk PACs are located within the Sagehen Project Area, and surveys indicate the majority of these PACs are occupied as evidenced by reproduction or detection of adults and/or young in recent years. Suitable nesting and foraging habitat for this species occurs throughout the Project Area. Northern goshawks and their habitat could be adversely affected by implementation of proposed silvicultural and fuels prescriptions.

Issue 3. One California spotted owl PAC and one HCRA are located within the Sagehen Project Area. While recent surveys indicate the PAC has been occupied by adults, its reproductive status over the past 20 years (since 1991) has remained unknown. While the majority of habitat within the Sagehen Project Area is largely unsuitable for spotted owls, there is concern that implementation of proposed silvicultural and fuels prescriptions could adversely affect this species and its habitat.

Issue 4. A key purpose of the Sagehen Project is to design a pattern of strategically placed area treatments (SPLATs) that is effective in modifying landscape-scale fire behavior. There is concern that treatments designed to meet the Project's multiple objectives could potentially compromise the effectiveness of the Project's SPLATs in moderating landscape fire behavior.

The key issues have been addressed through project design features: refer to the previous discussions under the headings: (1) "Ecological Restoration and Habitat Protection/Enhancement for the Marten,"

which provides details regarding approaches used to design silvicultural and fuels prescriptions to address concerns about potential impacts on habitat for the marten and other old forest associated species and (2) "How Proposed Treatments Affect Fire Behavior," which details approaches used to ensure that treatment prescriptions designed to meet multiple objectives would meet the Project's purpose of modifying landscape-scale fire behavior. Key issues are further addressed through mitigation in the form of management requirements incorporated into the proposed action, which are described in detail in Chapter 2 of this EA. Finally, the key issues are addressed in the environmental effects analyses presented in Chapter 3 of this EA.

Chapter 2: Alternatives

This chapter describes and compares Alternative 1 (Proposed Action), which has been designed to meet the purpose and need for action described in Chapter 1, Alternative 2 (No Action) and Alternative 3 (Non-commercial Funding). This chapter also details the proposed action's design features and management requirements. The intent of these features and requirements is to minimize adverse environmental impacts and ensure that the proposed action is consistent with Forest Plan standards and guidelines. Finally, this chapter displays the three alternatives in comparative form, defining the differences between them and providing a basis for a choice among the options by the Responsible Officials.

Alternative 1: Proposed Action

Note to reader: As a response to comments raised, the proposed action has been slightly modified: Unit 39 as described in the preliminary EA has been dropped from the proposed action. The acreages displayed in the section below and in Chapter 2 reflect the removal of this unit. In addition, effects of dropping Unit 39 on goshawk habitat in the NE Sagehen goshawk protected activity center (PAC) are addressed in the Biological Evaluation and summarized in Chapter 3 of this EA. Given that dropping Unit 39 results in such a small change in the overall proposed treatment acreage (a decrease of 1.2 percent), other resource analyses presented in Chapter 3 continue to be based on the original assumption that Unit 39 would be underburned only, as initially proposed. Due to the small size of this unit and the original proposal to only underburn this unit, removal of Unit 39 will not measurably change the effects analyses detailed in the Project's specialist reports and summarized in Chapter 3 of this document.

Alternative 1, the proposed action, was developed to meet the purpose and need for the project. The design and treatment methods of Alternative 1 are described in detail below.

Overall Goals and Treatment Objectives

As stated in Chapter 1, one of the main outcomes of the collaborative process was the designation of a number of emphasis areas within the boundaries of the proposed treatment units (original SPLAT boundaries). These emphasis areas became subunits within the treatment units where management would be focused and modified depending on the intent of each emphasis area. Three primary objectives are all reflected emphasis areas 1-7, albeit in different orders of priority. These included: (1) Pacific marten habitat protection and/or enhancement, (2) stand level ecological restoration, and (3) fuels reduction. For emphasis area 8, the objectives were focused on aspen restoration and enhancement.

For emphasis areas 1-7, a common set of metrics were identified to assess different post-treatment stand conditions, which would reflect the primary treatment objectives of that area. The metrics used include: (a) basal area retention, especially in trees greater than 20 inches diameter at breast height (dbh), (b) canopy cover, (c) snag density, (d) large and small down woody material, (e) short snag (or high stump) densities, (f) tree species composition, (g) dense cover areas (DCAs) with multiple tree ages,

and early seral openings (ESOs), and (h) fire behavior modeled values under 90th percentile weather conditions, including flame lengths and predicted crown fire and associated larger tree mortality.

While it is preferred that prescribed and natural fire become two primary management tools over the long term in all the emphasis areas, interim steps are needed so that fuels may be reduced to a more natural level, allowing fire to occur as it would have if fuels had not built up to unnatural levels. In order to facilitate that, near term management goals include the use of silvicultural and fire/fuels prescriptions and treatment methods that can, to a certain extent, mimic the effects of natural fire. Once these treatments have been applied it is hoped that prescribed or natural fire could occur without heavy mortality and uncharacteristically severe effects. These prescriptions and treatment methods and how they apply to emphasis areas (subunits), are detailed in the sections below beginning with "Prescriptions and Treatments". Directly below are sections that explain the overall goals and treatment objectives for each emphasis area.

Sagehen Proposed Action Map

Each emphasis area is represented by a different color on the map of the proposed action in Appendix B. These colors translate into subunits within the proposed treatment unit boundaries. For example, in treatment unit 38, the two discontinuous green areas are both emphasis area 1 and they are both designated subunit 38-1. In another example, treatment unit 213 is comprised of emphasis areas 1 (green), 2 (blue), 4 (fuchsia), 5 (gray), 6 (orange), and 7 (yellow). It therefore has subunits 213-1, 213-2, 213-4, 213-5, 213-6, and 213-7. Unit 80 is comprised only of emphasis area 8 (purple), and therefore is designated 80-8.

Emphasis Areas 1 and 3

Emphasis areas 1 and 3 represent some of the high quality marten habitat (defined in Table 1.1) currently existing within the Sagehen Basin. Emphasis area 1 (green areas on map of Alternative 1, Appendix B) includes high value habitats on north facing slopes, on ridges, and on higher elevation south facing slopes (above 6,725 feet). Emphasis area 3 includes high value habitats on lower elevation south facing slopes. High quality habitat for marten also exists outside the treatment unit emphasis areas, primarily along and south of Sagehen Creek and west of unit 46. There are also some scattered pockets of high value habitat north of Sagehen Creek. Because emphasis area 3 is very limited in total area, it was combined with either emphasis area 1 or emphasis area 2 (also high value marten habitat), whichever was closer. Therefore there is no mapped emphasis area 3 and there are no metrics assigned to it. Because numbers were already assigned to emphasis areas when emphasis area 3 was combined with others, re-numbering was not done. This discussion is intended to reduce confusion as to why emphasis area 3 is not shown on the map and why it will not be discussed further in this document. Within the treatment units, approximately 453 acres are identified as emphasis area 1 (see Table 2.2 below).

Emphasis area 1 values vary above and below 6,725 feet (2,050m), especially on north and east facing slopes in the southwest portion of the Basin (south of Sagehen Creek and west of the Donner Fire area). Areas above 6,725 feet in the southwest portion of the Basin are of relatively higher importance to marten than areas below 6,725 feet and to areas above 6,725 feet in the northeast portion of the Basin.

As stated in Spencer (1981), “martens in the upper basin (>2,050m) preferred stands with larger trees than those in the lower basin, reflecting their affinity for old-growth red fir stands.” and that the change from lodgepole/white fir to red fir occurs at 2,050m in elevation on the north and east facing slopes in the southwest portion (south of Sagehen Creek and west of Donner Fire area) of the Basin. This generally occurs in treatment units 156 and 213 and parts of treatment unit 163, see Alternative 1 map, Appendix B.

The primary goal is to manage emphasis area 1 for both the conservation and restoration of marten habitat values both in the near term and long term. Secondary and tertiary goals include ecological restoration and fuels reduction, respectively. To manage habitats for marten, this emphasis area would maintain relatively higher basal areas, specifically of larger trees, as compared to all the other emphasis areas. Some trees would likely be removed but basal areas would be lowered only to the extent to facilitate the faster creation of a higher proportion of trees greater than 20 inches dbh while at the same time retaining enough basal area and canopy cover to maintain the emphasis area as current high quality habitat. Of the designated emphasis areas, emphasis area 1 retains/recruits the highest number of snags, short snags/high stumps, and existing DCAs. This would maintain components and areas important for resting/denning martens and would ensure future recruitment of important habitat elements and areas. High amounts of large down wood material and high stumps are also important to provide foraging areas and rest sites. In addition, as compared to the rest of emphasis area 1, relatively higher basal areas, more DCAs, and a higher percentage of red fir and white fir are afforded higher prominence in the portions of the emphasis area above 6,725 feet in the southwest portion of the Basin due to the relatively higher habitat values present in this area. Another goal for emphasis area 1 is to maintain reasonable connectivity (i.e. cover from predators and access to adjoining areas) across the area. Recent evidence (Moriarty, pers. comm.) suggests that marten are vulnerable to predation if sufficient cover between preferred resting and foraging sites is lacking.

Even though the primary goal for this emphasis area is to manage for marten use, it is also very important to manage for stand level ecological restoration and a heterogeneous forest which will be more resilient to fire and climate-induced stresses. Treatment objective ranges for basal area retention, canopy cover, percentage of the subunit in DCAs and/or ESOs, and tree species compositions help to ensure that a heterogeneous condition would result post treatment. Also, in order to address fuels reduction and the need to reduce the potential of uncharacteristically severe wildfire effects, treatment objectives that address ladder fuel removal, the spatial arrangement of areas where ladder fuels would not be removed, and the horizontal arrangement of fuels to break up continuous fuel beds help to address these concerns.

Emphasis Areas 2 and 4

Emphasis areas 2 and 4 include the drainage bottoms that currently support high quality marten habitat (emphasis area 2, blue areas on Alternative 1 Map, Appendix B) and the drainage bottoms that do not currently support high quality marten habitat, i.e. the habitat does not currently meet the criteria described in Table 1.1 (emphasis area 4, fuchsia areas on Alternative 1 Map, Appendix B). As stated above, high quality habitat for marten also exists outside the treatment unit emphasis areas. Emphasis areas 2 and 4 include perennial stream courses and other intermittent and ephemeral drainages

throughout the Basin. These locations tend to be relatively more mesic, retain moisture longer through the season and generally support more dense and diverse vegetation conditions than the surrounding stands. Stream courses and other mesic drainage bottom areas are known to be preferable habitat for many wildlife species. They tend to have more herbaceous vegetation cover and microhabitats, provide more escape cover, are accessible to permanent water sources, and support a larger volume and diversity of vertebrates and invertebrates. Thus emphasis areas 2 and 4 intend to maintain and enhance these conditions. In cases where trees are encroaching on meadows or open herbaceous areas, the basal area/crown cover of trees would be reduced to maintain and/or restore meadow habitat as well as encourage herbaceous cover. By contrast, some drainages tend to be relatively more xeric and have fewer to no adjoining wet meadows or similar features. Under these conditions these areas still retain moisture for a longer period of the year than surrounding stands and tend to support denser vegetation and often larger trees. Under these circumstances the objective is to maintain higher basal areas and crown cover and a higher proportion of dense vegetation and structural diversity that these areas tend to provide. Within the treatment units, approximately 103 acres are identified as emphasis area 2 and 173 acres are identified as emphasis area 4 (see Table 2.2 below).

The primary distinction between emphasis area 2 and emphasis area 4 is the consistent presence of greater than 11 inches dbh lodgepole pine as the dominant tree species in most of emphasis area 2 with an average canopy cover of 40% or more. Emphasis area 4 can include perennial and intermittent streams, as well as mesic and relatively xeric ephemeral drainages with a variety of tree cover types. Overall, emphasis areas 2 and 4 are intended to provide higher basal areas of larger trees than the areas surrounding them except for emphasis area 1. They would provide relatively high canopy closures within the treed areas but would also allow enough light for well-developed herbaceous ground cover where sufficient water exists. In addition they would also have higher proportions of snags and short snags/high stumps which would provide resting sites, foraging features, and prey cover for martens. Because of their preferential use for foraging habitat, treatment objectives include the highest retention of large/small down wood components. The differences arise in emphasis area 4 because it includes not only perennial stream courses, but also many intermittent and ephemeral drainages which are highly variable in moisture conditions, vegetation types, position on slope, and aspect. More variation occurs in this emphasis area, thus treatment objectives are also more variable. Relatively more mesic conditions would have more downed logs and high stumps and would be composed of more lodgepole pine; while more xeric conditions would have less dead wood components and would trend on a scale more towards white and red fir and/or ponderosa or Jeffrey pine (depending on slope/aspect).

Even though the primary goal for these emphasis areas is to manage for marten use, especially foraging habitat, it is also very important to manage for stand level ecological restoration and a heterogeneous forest which will be more resilient to fire and climate-induced stresses. Treatment objective ranges for basal area retention, canopy cover, snag, down wood, and short snag densities, percentage of the subunit in DCAs and/or ESOs, and tree species compositions help to ensure that a heterogeneous condition would result post treatment. Also, in order to address fuels reduction and the need to reduce the potential of uncharacteristically severe wildfire effects, treatment objectives that address ladder fuel removal, the spatial arrangement of areas where ladder fuels would not be removed, and the horizontal arrangement of fuels to break up continuous fuel beds help to address these concerns.

Emphasis Area 5

Emphasis area 5 (gray areas on Alternative 1 Map, Appendix B) represents north facing slopes that are not currently high quality marten habitat. The primary goal in emphasis area 5 is to work towards stand level ecological restoration, followed by marten habitat enhancement and fuels reduction. In general the treatment objectives would move the area towards a more heterogeneous forest that would improve resilience to fire and climate induced stresses, while at the same time still providing habitat elements for old forest associated sensitive wildlife species, such as the marten, northern goshawk, and California spotted owl. This emphasis area is also present in some plantations (units 46, 76, 87, and 99). For the Sagehen Project, the objectives in these plantations would be focused on the first steps of achieving a resilient heterogeneous forest. Some examples of this are retaining some young porcupine damaged trees that could grow into trees with split tops and other defects suitable for nesting/resting structures, and retaining residual or legacy trees and areas that are sparsely treed – for plantations, these areas would become similar features to DCAs and ESOs. See the "Prescriptions and Treatments" section below for more detail.

For the remainder of emphasis area 5, outside of plantations, objectives include retaining individual trees, small groups of trees, retaining existing DCAs, and creating ESOs that can support younger cohorts of a variety of species. Due to the more northerly exposure, emphasis area 5 would support more basal area and canopy cover as compared to ridges and south facing slopes. However it would support less basal area and canopy cover than drainages, because of the more xeric conditions, and less than emphasis area 1 because of the objectives to maintain higher basal areas and canopy cover for high quality marten habitat. Overall however, treatment objectives specify that enough basal area, canopy cover, and habitat components such as snags, down wood, short snags, and DCAs would be retained to ensure that the emphasis area retains, or in plantations, facilitates the creation of, important habitat structures for wildlife and provides suitable habitat or moves the habitat towards suitability for old forest species. Also, as in emphasis areas 1, 2, and 4, to address fuels reduction and the need to reduce the potential of uncharacteristically severe wildfire effects, treatment objectives are designed that address ladder fuel removal, the spatial arrangement of areas where ladder fuels would not be removed, and the horizontal arrangement of fuels to break up continuous fuel beds. Within the treatment units, approximately 996 acres are identified as emphasis area 5 (see Table 2.2 below).

Emphasis Areas 6 and 7

Emphasis area 6 (orange areas on Alternative 1 Map, Appendix B) represents vegetation types not identified as high value marten habitat on south facing slopes and emphasis area 7 (yellow areas on Alternative 1 Map, Appendix B) represents vegetation types not identified as high value marten habitat on ridges. In emphasis areas 6 and 7 where fuels reduction is the highest priority, treatments are designed to substantially modify wildfire behavior and reduce the potential of uncharacteristically severe wildfire effects. Although important in all the other emphasis areas, in emphasis areas 6 and 7 especially, the post treatment fire behavior is targeted to meet conditions for SPLATs. SPLATs are designed to achieve, under 90th percentile fire weather conditions, an average of a four foot flame length, that surface and ladder fuels would be removed as needed to meet less than 20 percent fire mortality in dominant and co-dominant trees, and that tree crowns would be thinned to meet less than 20 percent probability of initiation of crown fire (SNFPA ROD 2004, Standard and Guideline #5, pg. 50).

The secondary priority of stand level ecological restoration in these areas is focused on facilitating conditions that would result under an active fire regime, which includes a more heterogeneous forest that is resilient to fire and climate induced stresses. Within the treatment units, approximately 740 acres are identified as emphasis area 6 and 150 acres are identified as emphasis area 7 (see Table 2.2 below).

Overall, in emphasis areas 6 and 7, basal area and canopy cover would be lower than in emphasis areas 1-5. In emphasis area 6, basal area would be reduced to a level that would help increase the pace of tree growth so that a higher percentage of the basal area is in larger (greater than or equal to 20 inches dbh) trees in a shorter amount of time. In emphasis areas 6 and 7, the intent is produce stand conditions that are more similar to those that would have been produced under an active fire regime. A more heterogeneous forest would be created by retaining individual trees, with particular emphasis on tree species more suited to xeric environments, retaining small groups of trees, retaining DCAs, and creating ESOs that can support younger cohorts of a variety of species.

Emphasis areas 6 and 7 are also present in some plantations (units 46, 76, and 87, and emphasis area 6 in unit 99). In plantations, fuels reduction objectives to modify wildfire behavior and reduce severe wildfire effects can usually be achieved in a relatively short timeframe. For the Sagehen Project, the secondary objectives in these plantations would be focused on the first steps of achieving heterogeneous forest. Some examples of this are retaining some young porcupine damaged trees that could grow into trees with split tops and other defects suitable for nesting/resting structures, and retaining residual or legacy trees and areas that are sparsely treed – for plantations, these areas would become similar features to DCAs and ESOs. See the "Prescriptions and Treatments" section below for more detail.

In addition, the third priority of these areas is marten habitat. Because of their topographic position on drier south facing slopes and ridges, usually with shallower soils, it is unlikely these emphasis areas would develop high quality marten denning/resting habitat over the long term. The exposures and soils would likely preclude the development of dense, large treed fir stands. However these areas could provide for marten movement. Therefore the objectives include avoiding the creation of barriers to marten movement (i.e. large openings). Therefore enough basal area, canopy cover, and habitat components such as snags, down wood, and existing DCAs would be retained to allow marten movement in/through these emphasis areas.

Emphasis Area 8

Emphasis area 8 (purple areas on Alternative 1 Map, Appendix B) is unique in that its only goal is stand level ecological restoration of aspen stands. However this goal is solely focused on a small forest stand scale. This does not represent all aspen stands within the Basin. Where small aspen stands exist within the potential treatment units, the goal is to improve/restore the aspen stands. Under a more active fire regime, conifer encroachment into aspen stands would be minimized and the aspens would be able to reproduce through suckering. However, with a lack of fire disturbances, conifers are able to shade out aspens and impede successful reproduction. The only objectives considered in this emphasis area are minimizing direct conifer competition to existing aspens and to remove conifers to the extent that the aspen stand could expand appropriately to the extent site conditions would allow. Within the treatment units, approximately 6 acres are identified as emphasis area 8 (see Table 2.2 below).

Prescriptions and Treatments

The proposed action would apply a suite of integrated silvicultural and fire/fuels prescriptions within each treatment unit. Application of the prescriptions (via various treatment methods) would set the stage for achieving emphasis area treatment objectives, described in the preceding section. The sections below describe the prescriptions and treatment methods proposed for the Sagehen Project. See Table 2.1 *Prescription and Method Summary* below for the units to which each of the following prescriptions applies.

Order of Prescription Application

Implementing the following silvicultural prescriptions involves careful consideration of fire: both the follow-up application of fire/fuels prescriptions as well as the stand structure conditions that would likely develop under an active fire regime. On-the-ground decisions about which individual trees and groups of trees to retain are made in light of (1) ensuring overall stand structure will remain intact following application of prescribed fire and (2) mimicking stand structures that would develop under an active fire regime.

The prescriptions can be highly variable and site-specific, and are set within the context of the existing stand's structure, tree species composition, and as compared to the emphasis area objectives for each subunit. For most units within the Sagehen Project, implementing the following silvicultural prescriptions involves applying each of the first five prescriptions in a step-wise fashion:

- The first step involves identifying both the dense cover areas (DCAs) and early seral openings (ESOs), and laying out their boundaries out on the ground.
- Next, the trees suitable for legacy tree treatments are identified and the surrounding trees proposed for removal are marked.
- After this is done, the variable thinning mark is anchored to DCAs, ESOs, and legacy tree treatments.
- In addition, the suppressed cut prescription is applied to remove suppressed trees contributing to ladder fuels outside of DCAs.
- Finally in subunits where the current snag/short snag densities are substantially below desired densities, decadent feature enhancements (partial tree girdling and/or short snag creation) would be identified for implementation either by machinery or hand.

All five of these prescriptions would be applied, in a step-wise fashion, for each identified unit (see Table 2.1). If there are no trees suitable for legacy tree treatment in a given unit, that prescription would be dropped during marking. The remaining two prescriptions, plantation thinning and aspen restoration are applied specifically to plantations and aspen stands, respectively.

Silvicultural Prescriptions

Dense Cover Areas (DCAs) and Early Seral Openings (ESOs)

Dense cover areas (DCAs) are small areas distributed within treatment units that provide continuous vertical and horizontal cover with a mixture of shrubs and trees along with large and small down wood, snags, and high stumps. DCAs would typically contain clumps of trees of various size classes as well as a

variety of snag and down wood sizes. These existing DCAs, ranging in size from 0.25-1 acre, would contribute to/enhance within-stand horizontal and vertical structural diversity and provide important old forest and/or mid seral habitat elements. For example existing DCAs can be representative of multiple layered late seral conditions with high levels of decadence and dead wood. They can also represent a more mid seral condition with brush and a medium sized tree overstory that provide important hiding and resting cover for wildlife and provide foraging and/or movement cover for martens and other late seral species. ESOs would be comprised of dense young regenerating trees and/or shrubs to provide early successional habitat within larger stands managed for late successional or old forest habitat. ESOs, from 0.25-0.50 acre, would enhance within-stand age and species diversity as well as provide prey and foraging habitat for old forest associated wildlife species. Some DCAs are planned around small fens in units 46, 85, and 98. The area would encompass not only the fen but also some of the surrounding forest stand. Both vertical structural diversity and an early seral stage would be represented.

Two primary methods would be used to retain and create DCAs or ESOs: For DCAs, an area would be designated that has multiple wildlife habitat elements, such as large down woody material, a mixture of tree age classes (including solitary and groups of large trees), large snags, multiple tree canopy layers; and/or trees with features associated with wildlife use (for example, platforms, mistletoe brooms, forked tops, and cavities). No mechanical tree removal would be conducted in these “existing DCAs”. For ESOs, by taking advantage of existing conditions, such as areas of sparse tree cover, thinner soils, or pockets of extensive tree mortality, openings would be created by removing most or all of the existing trees and either planting or allowing natural shrub and/or tree regeneration to create an ESO of early successional habitat.

Prescribed fire would be an important management tool within DCAs and ESOs. For DCAs comprised of multiple sizes of trees, snags, and down wood, prescribed fire would be carefully applied to maintain key habitat elements, particularly snags and down wood. While underburning in DCAs would likely result in some mortality of suppressed and subdominant trees, burning prescriptions would be designed to ensure the overall structure of the DCA would remain intact. For ESOs (regeneration areas), prescribed fire would be applied to regenerate shrubs and create suitable areas for shade-intolerant tree species to regenerate.

Photo 1:

Dense Cover Area, on left of photo, before trees to the right were removed under variable thinning and suppressed cut prescriptions. No trees were removed from within the DCA. (photo from Sagehen Test Plots 2010, emphasis area 5)

Photo 2:

Dense Cover Area, on left of photo, after trees to the right were removed under variable thinning and suppressed cut prescriptions. No trees were removed from within the DCA. (photo from Sagehen Test Plots 2010, emphasis area 5)

Legacy Tree Treatment

Legacy trees are the largest and/or oldest trees within a stand. A legacy tree is a large tree (typically greater than 24 inches dbh) that has remained on site while most of the original surrounding trees have been removed by either timber harvest or mortality due to fire, insects, drought, or disease. Hence, a legacy tree tends to be at least a generation older than the trees in the surrounding stand and is one of the largest trees in the stand. Legacy trees can occur singly or in groups, and often represent tree species that would occur under an active fire regime.

Legacy trees are not present within every stand, and, as a general rule, are somewhat rare in the Sagehen Project Area's forest stands, typically occurring at a density of one to two legacy trees per five acres. As with many other forest structural features, this value varies considerably depending on site history and conditions.

As stated above, the legacy tree treatment prescription is applied after the DCAs and ESOs are identified. In some cases legacy trees may occur within a DCA. In this case the DCA trumps the legacy tree treatment and trees surrounding the legacy tree are retained in the DCA. In other cases, a legacy tree may occur on the edge of an ESO. In this case, the ESO would be designed to, in effect, implement a partial legacy tree treatment in that trees removed in the ESO would also be trees that would have been removed in the legacy tree treatment. Legacy tree treatments would not be used to expand the resulting sizes of ESOs.

In some of the Project Area plantations, there are trees that survived the wildfires and subsequent salvage harvest, in these cases the trees are referred to as "residual" trees. While they do meet the definition of legacy trees, they occur in large enough groups that they would be treated differently than individual or small groups of legacy trees, see the Plantation Thinning prescription below.

Legacy tree treatment would involve removing trees up to 30 inches dbh around the legacy tree, however, existing stand structure would dictate the sizes of trees (up to a 30 inch dbh limit) to be removed. For example if the legacy tree was 28 inches dbh, trees up to 28 inches dbh could be removed, or if the legacy tree was 40 inches dbh and it was surrounded by 34 inches dbh trees, the largest tree that would be removed is 29.9 inches dbh. In no cases would trees be removed that are larger than 30 inches dbh, and trees larger than the legacy tree would not be removed. Legacy tree(s) typically occur as individuals when they are pines and occur in small (2-5 tree) clumps when they are firs.

This treatment is designed to increase the resiliency of large legacy trees from the effects of fire, drought, pathogens, and disease. Removing trees from around the legacy tree(s) accelerates tree root and diameter growth, thereby improving overall legacy tree health and resiliency. In addition, the removal of smaller, understory trees, particularly the shade tolerant, less fire-resistant white fir, removes ladder fuels, which could carry fire into the canopy of the legacy tree(s).

The distance of the tree removal around legacy tree(s) would be variable, based on site-specific conditions (such as extent of the drip line, aspect, and topography). For example, legacy tree(s) on slopes greater than 25 percent could have a treatment distance that extended approximately one and one-half tree lengths. In flatter areas, treatment distances could be shorter as flame lengths would be lower compared to those occurring on steeper slopes. Differences also arise on north facing versus south facing slopes. Treatment distances would typically be smaller on north facing slopes. In addition, treatment distance could be longer on the south side of the legacy tree versus the north side of the tree, based on expected topographic effects of the sun. Although varying conditions would dictate a range of proposed tree removal under and around legacy trees, the majority of legacy tree treatments would not extend beyond a half a tree length from the drip line of the tree and would rarely hold a consistent distance from the tree. For example the north side of a legacy tree may only be cleared to the drip line (removal of ladder fuels), while the south side of the tree may extend a half a tree length further. On the

rare occurrences where topographic conditions could increase flame lengths from surrounding trees (i.e. a legacy tree at the high end of a 35 percent slope) treatments may extend as much, but no further, than a tree and half-length only on the downhill side from the bole of the legacy tree. If this situation does occur and the acreage of that treatment exceeds 0.25 of an acre, then this treatment will also be accounted for as early seral opening (ESO) acreage.

Photo 3:

Legacy tree treatment, before surrounding trees were removed (photo from Sagehen Test Plots 2010, emphasis area 5)

Photo 4:

Legacy tree treatment, after surrounding trees were removed (photo from Sagehen Test Plots 2010, emphasis area 5)

Variable Thinning

The variable thinning prescription is highly site-specific, set within the context of the existing stand's structure and tree species composition. In general, variable thinning involves selective removal and retention of individual codominant and subdominant trees and/or small groups of codominant and subdominant trees. Variable thinning would occur throughout the areas outside of dense cover areas, early seral openings, and legacy tree treatment areas, varying by the prescriptions designed for each emphasis area. Thinning would be conducted to meet treatment subunit level objectives of basal area, canopy cover, tree species composition, and fire behavior (as described under "Prescription Metrics" below), and to increase stand level structural heterogeneity. As stated above, and especially for a variable thinning prescription, implementation involves careful consideration of fire: both the follow-up application of prescribed fire, as well as the stand structure conditions that would likely develop under an active fire regime. On-the-ground decisions about which individual trees and groups of trees to retain would be made in light of (1) ensuring overall stand structure would remain intact following application of prescribed fire and (2) mimicking stand structures that would develop under an active fire regime.

Variable thinning objectives include: (a) enhancing stand heterogeneity (by retaining groups of larger trees that can provide valuable wildlife habitat and creating subtle openings by thinning around these groups), (b) reducing fuels, and (c) work towards stand level ecological restoration. The variable thinning approach is based on the GTR 220 principle that varying stem density according to potential fire intensity effects on stand structure can create horizontal heterogeneity inherent to these landscapes. As such, the variable thinning primarily focuses on removing ladder fuels, subdominant and codominant shade-tolerant trees (such as white fir), and some subdominant and codominant shade-intolerant trees (such as Jeffrey or ponderosa pine). It is not based on spacing guidelines but rather works within the context of the existing stand to emphasize retaining desired tree species compositions, basal areas, and desired stand structure elements (such as trees with some level of decadence or "defect").

Variable thinning would be applied using the following guidelines:

- Generally favor retention of pines over firs, especially in southerly facing areas and on ridges. In areas of more fir dominance, give retention preference to red fir over white fir. Retained groups of larger trees (described under the bullet below) may include fir trees. Overall the emphasis for retained groups of trees is preserving or enhancing desirable stand structure rather managing for any particular species composition.
- Retain groups of larger trees, generally comprised of five to ten (or more) trees of roughly similar size. Ideally, some of the retained trees should have desirable habitat features, such as forked or broken tops. Remove trees adjacent to these retained groups to improve the overall health and resiliency of the group to drought, insects and disease.
- Where a few (less than five) trees occur together, or where trees are scattered, retain the more vigorous trees by removing subdominant and, in some cases, codominant trees around them to reduce ladder fuels and competition for light, water, and nutrients.
- In areas of greater fir dominance where large trees tend to grow in more of a clumped nature, emphasize retaining clumps, or groups, of generally five to ten trees, and removing trees adjacent to these retained clumps to create small, variably shaped gaps.

- When making site-specific determinations on individual tree removal/retention preferences, vary the choices made so as to increase the variability at the micro-site scale.

Photo 5:

Combination of variable thinning and suppressed cut prescriptions, before tree removal (photo from Sagehen Test Plots 2010, emphasis area 5)

Photo 6:

Combination of variable thinning and suppressed cut prescriptions, after tree removal (photo from Sagehen Test Plots 2010, emphasis area 5)

Suppressed Cut

A suppressed tree is typically no larger than ten inches dbh (usually ranging between one and five inches dbh) *and* is a component of a stand's understory, where there is an overstory of dominant, codominant, and subdominant trees. Suppressed trees, in general, have little capacity to release (initiate increased growth rates), even if the overstory is removed. These trees often make up the lower levels of ladder

fuels, and the suppressed tree layer combined with subdominant trees helps connect the forest floor into the crowns of dominant/codominant trees, which can increase fire severity and the potential for crown fire.

The suppressed cut would remove suppressed trees (down to one inch dbh for hand thinning and down to three inches dbh for mechanical thinning), as described above, within treatment units outside of dense cover areas. The suppressed cut prescription would not be applied within dense cover areas. This would retain a percentage of the suppressed tree size class within the treatment units, enhancing within-stand variability from a tree size standpoint. Suppressed tree removal outside dense cover areas would facilitate use of prescribed fire while helping to minimize the risks of crown fire by removing some ladder fuels.

Decadent Feature Enhancement

This prescription encompasses two different treatments; partial tree girdling and short snag creation. Partial tree girdling would occur inside and outside of DCAs and short snag creation would only occur in DCAs. Both treatments would only be applied in subunits where the current snag/short snag densities are substantially below desired densities. In all cases however, this prescription would not be applied in emphasis area 7. In some cases, just the partial tree girdling or the short snag creation would be applied in a given emphasis area (subunit) and in other cases both treatments would be applied; it depends on the existing conditions within the subunit.

Partial tree girdling would involve girdling (cutting off the bark layer deep enough to sever the tree's vascular system in the cambium) of individual trees 15-30 inches dbh. The bark layer would be removed in a 6-12 inch band covering approximately ⅓ of the diameter of pine trees and ½ of the diameter of fir trees. The goal of this treatment is to selectively wound and therefore weaken trees. These weakened trees would become more susceptible to environmental stresses, insect attack, and/or fungus/rot infection and therefore become snags likely before a neighboring, non-girdled tree would. By partially girdling and wounding trees, it is anticipated that the trees would become snags over a longer timeframe rather than die immediately, like what would happen if a tree were completely girdled.

The selection of trees for partial tree girdling would occur after the above four prescriptions had been applied (marked). Trees selected outside of DCAs for partial girdling would be trees already selected under the variable thinning prescription for removal. Therefore these trees would be accounted for when calculations of basal area removal and trees removed per acre are tallied, however they would be left on site. These trees would be among the largest trees available (under 30 inches dbh). Trees selected for partial girdling in DCAs would be designated based on the site specific conditions in the DCAs and would be trees that would provide needed habitat structure in the DCAs. Between 500 and 600 trees would be treated with partial tree girdling to enhance decadent features in the subunits over the long term.

Short snag creation involves cutting a tree (preferentially a white fir), on the outside edge, but within a DCA, at a height of 10-20 feet above the ground. The height would be based on the highest point a piece of machinery such as a feller buncher, could reach to cut the tree. The top of the tree would be felled into the interior of the DCA and left to contribute to down log densities. Trees selected for this

treatment would be 15-30 inches dbh. The goal of this treatment is to immediately create snags at an intermediate height inside of DCAs. These short snags would be expected to provide suitable perches/rest sites and would be tall enough to be above typical snow levels, thus also providing an access route under the snow for wildlife. Between 100 and 150 trees inside of DCAs would be selected for the short snag creation treatment.

Plantation Thinning

Plantations in the Sagehen Project Area were established in the 1960s and 1970s following the Independence and Donner Ridge wildfires. The plantations are largely comprised of planted Jeffrey pines; however, they also contain young trees that grew in naturally. The plantation thinning prescription is designed to facilitate and accelerate the continued growth of these young trees. The plantations currently contain some trees that survived wildfire and subsequent salvage harvest: these "residual" trees would not be removed. While they do meet the definition of legacy trees, residual trees in plantations would be treated differently than individual or small groups of legacy trees with a focus on removing ladder fuels to protect them during prescribed burning treatments. There also would be an emphasis on removing ladder fuels on the downhill sides of the residual trees where steep slopes may contribute to flame lengths reaching the residual trees.

Plantation thinning would involve mechanical thinning and/or mastication (mechanical grinding and crushing that *rearranges* material on site) of plantation trees and mastication of brush. Mastication changes a vertical large piece of fuel (i.e. a standing tree) into many smaller pieces of horizontal fuel. This is termed "*rearranging"* the fuels to a condition that allows the material to decompose more rapidly. The plantation thinning prescription would primarily focus on removing and/or rearranging trees between one and 12 inches dbh. An occasional tree between 12 and 18 inches dbh could be removed; however, this would occur only where mechanical cutting and removal systems were used. The majority of trees between 12 and 18 inches dbh would be retained. Because of the nature of plantations and the logistics of marking trees in extremely dense brush, trees would be thinned by description and a spacing guideline would be applied. Typically, retained trees would be spaced roughly 14 to 22 feet apart; however, where logistically possible, existing variable stand structure would be used to increase within-stand horizontal heterogeneity such that there would be some more dense and more open areas.

Plantation thinning would retain at least 120 trees per acre. Sufficient tree canopy cover would be maintained to suppress shrub growth under groups of trees; however, retarding shrub growth over the entire treatment unit would not be a specific objective. Although the primary objective of plantation thinning is to accelerate the growth of retained trees, a secondary objective is to foster some within-stand defect trees. To meet this secondary objective, plantation thinning would retain an average of ten to 12 trees per acre with injuries, split tops, and/or porcupine damage.

Shrubs growing under the drip line of retained trees would be masticated. Other areas of snow brush, manzanita, and white thorn outside the drip lines would also be masticated to decrease the fire hazard and provide opportunities for brush regeneration. Further, patches of bitterbrush and *Ribes* outside of tree drip lines would not be masticated unless they posed a fire hazard (ladder fuels) to retained trees/groups of trees. Bitterbrush is a preferred browse species for mule deer and it occurs in some

homogeneous small patches in the plantations. These patches provide valuable foraging habitat. Because bitterbrush and *Ribes* do not regenerate (stump sprout) very well after mastication, unless posing a direct ladder fuels hazard, these species would not be masticated.

In addition to spacing guideline ranges, other measures would be implemented to increase within-stand horizontal heterogeneity. Where less than ten trees per acre are present, no trees would be thinned and shrubs would not be masticated; however, these areas could be underburned. Because the plantations are largely composed of Jeffrey pines, species preference for retention would focus on other species, if they are present. This could mean that a larger pine would be proposed for removal/mastication if it is in close proximity to a tree of another species, such as red fir.

Areas containing "residual" trees as well as areas that currently have less than ten trees per acre, which would not be mechanically thinned or masticated, would serve functions similar to DCAs and ESOs in the treated plantations. In addition, identified drainage bottoms within plantations would not be treated, providing additional areas like DCAs. Based on existing conditions in the plantation treatment units, it is estimated that at least ten percent of the overall plantation acreage would be included in these residual tree zones, sparsely treed areas, and drainages. These areas would enhance heterogeneity in the treated plantations.

Photo 7:

Example of typical plantation thinning area, showing brush that would be masticated and trees that would be thinned. (photo of unit 46, see map of Alternative 1, Appendix B)

Aspen Restoration

An aspen restoration prescription involves selectively removing conifers from stands of aspen that are at risk of loss because they are being crowded and shaded by thickets of small lodgepole pine or they are being overtopped by conifers. These stands typically have a much higher percentage of conifers than aspen, and have little aspen regeneration. Conifer removal would occur by hand cutting or mechanical cutting methods. When treated by hand, typically most conifers from one to 16 inches dbh would be cut and removed from site and larger conifers girdled to create snags. When treated by mechanical means, conifers greater than three inches dbh that are overtopping and/or crowding aspens would be removed.

Photo 8:

Example of typical aspen restoration area, showing conifers that would be removed and/or girdled. (photo of unit 80, emphasis area 8, see map of Alternative 1, Appendix B)

Silvicultural Treatment Methods

Silvicultural prescriptions would be implemented using ground-based mechanized equipment or by hand, as described below.

Mechanical Thinning

Mechanical thinning is a harvest activity, which, under the Sagehen Project would primarily utilize ground-based equipment (tractors, feller bunchers and some chainsaw work) to fell and remove identified trees while retaining and protecting desirable trees to accomplish fuels reduction, marten habitat enhancement and restoration, and stand level ecological restoration objectives set within each treatment unit. A network of skid trails (in the case of ground-based thinning operations), landings, and, in some cases, temporary roads (which are removed following project activities) would be used to transport and collect harvested material. Equipment will be used on slopes no greater than 30 percent with short pitches up to 200 feet on up to 35 percent slopes. Short pitches over 35 percent slope may be agreed to on a site-specific basis. It should be noted that while most work is done primarily by machinery, there also is an inherent hand treatment component as well. For example some hand chainsaw work may be needed to protect specific trees of concern and partial tree girdling would also be done by hand, even in a mechanical thinning area.

Hand Thinning

Hand thinning is an activity that utilizes crews with chainsaws or handsaws that cut understory conifers less than 16 inches dbh to accomplish fuels reduction, marten habitat enhancement and restoration, and stand-level ecological restoration objectives set for the treatment unit. If hand felled material

contributes to unacceptable fuel loading, this material may be hand piled outside the drip lines of desirable trees and burned when conditions permit a minimum amount of mortality.

Mastication

A masticator is a low ground pressure piece of equipment that "chews" up brush and small understory trees to reduce competition. The machine mechanically grinds and crushes this material and down woody fuels and distributes the resulting small pieces around the site. Mastication is also a Fire/Fuels Treatment Method – see below.

Fire/Fuels Prescriptions

Fire/fuels prescriptions would be aimed at reducing hazardous surface and ladder fuels within the treatment units and providing conditions that would enable subsequent use of prescribed fire to maintain suitable fuels conditions. Fire/fuels prescriptions include prescribed surface fire as well as pile burning and lop and scatter prescriptions.

Surface Fire Prescription

A surface fire is a fire that burns live and dead fuels at or near the surface of the ground, mostly by flaming combustion. A surface fire prescription is usually implemented by an underburn. Surface fire prescriptions are typically designed to consume surface and ladder fuels and to mimic fire that would occur in an active fire regime. Surface fire prescriptions can be applied under spring-like and fall-like conditions. Spring-like conditions are defined by relatively high live fuel moistures, high 1000 hour size ("coarse woody debris", three inches diameter and greater) fuel moistures, and soils that are relatively moist beneath the surface fuels. Under spring-like conditions, it is expected that surface fires would have moderate to high consumption of 1-100 hour size fuels ("fine woody debris", ranging from 0.00-2.99 inches diameter) and minimal consumption of 1000+ hour fuels with mortality primarily expected in subdominant tree size classes. Fall-like conditions are defined by relatively low live fuel moistures, lower 1000 hour fuel moistures, and drier soils with dry organic layers beneath the litter layer. Under fall-like conditions, it is expected that burning would be primarily surface fires with higher flame lengths, and faster burn times as compared to burning under spring-like conditions. It would have high consumption of 1-100 hour size fuels and moderate to high consumption of 1000+ hour fuels, and with mortality expected in subdominant and some codominant tree size classes. Depending on cycles of drought and wet weather, spring-like and fall-like conditions can occur throughout the year. For the Sagehen Project, spring-like condition surface fire prescriptions would be emphasized, however due to limited suitable burning conditions, surface fire prescriptions under fall-like conditions would be implemented in some cases. In these cases, extra measures to protect large dead wood, such as creating firelines around large logs/snags, would be implemented.

Pile Burn Prescription

A pile burn prescription is designed to remove surface fuels, both fuels generated from silvicultural treatments (activity fuels) and existing fuels on the ground. A pile burn prescription can be implemented by hand or by machinery (typically a grapple piler – see below). In general, small down wood is placed in piles for future burning. Pile location and size is dictated by existing conditions, however piles would be preferentially placed outside of sensitive areas such as riparian conservation areas and cultural resource sites. Piles of fuels typically are burned under fall-like conditions, in winter months, or during periods of

low fire danger. This prescription removes surface fuels in the treatment units and is used to mimic underburning where sensitive areas prevent unit-wide application of underburning.

Lop and Scatter

A lop and scatter prescription does not remove fuels from treated areas. It prescribes changing the size and arrangement of the fuels. Lop and scatter prescriptions usually deal with activity generated fuels as a result of tree removal (tree tops and branches), however it can also apply to brush and standing ladder fuels. The purpose of a lop and scatter prescription, by changing the arrangement and size of fuels, is to take the fuels to a condition that allows the material to break down more rapidly.

Fire/Fuels Treatment Methods

Often, the silvicultural treatment would partially achieve hazardous fuels reduction objectives, and, in the case of mastication, could fully achieve fuels reduction objectives. Most of the silvicultural treatments however would be followed by a fire/fuels treatment, aimed at reducing surface fuels and residual ladder fuels.

Prescribed fire constitutes much of the proposed follow-up fuels treatments for the Sagehen Project treatment units. Prescribed fire refers to any fire ignited by management actions to meet specific objectives. Prescribed fire can include underburning (intentionally set surface and ground fire) and burning of hand and machine constructed piles. Associated activities include creating firelines to prevent fire spread from treatment units as well as prevent the site-specific ignition of key habitat components, such as snags and down logs.

Underburning

Underburning is a generalized term used when applying prescribed fire to large areas and is typically the treatment method for a surface fire prescription. Underburning targets surface fuels, some understory, and, in rare cases, larger trees. Surface fuels are the primary agent of fire spread. The objective is to apply controlled fire under optimum conditions where the treatment can modify fuel conditions to effectively reduce fire behavior and the corresponding intensity of a future wildfire. Within some areas proposed for burning, the goal of the treatment may be to consume a significant portion of the existing surface fuels that could cause high wildfire intensities, and/or the consume understory vegetation (ladder fuels) in order to reduce future fire severity and to create conditions that allow for future prescribed underburning opportunities. In other areas, underburning is used to create new growth of native shrub species and forage opportunities for wildlife. Underburning most closely mimics low-intensity fire that would occur in an active fire regime. Underburning, especially on south and west facing slopes, is typically conducted under spring-like conditions. A more mosaic burn pattern is created by underburning in spring-like conditions as compared to fall-like conditions; with some areas minimally burned and overall less fuel consumption. For the Sagehen Project proposal, underburning would be applied on a unit-wide basis, in other words, where underburning is proposed it would be conducted across the entire treatment unit and across all subunits (emphasis areas) within that treatment unit.

Photo 9:

Example of underburning under fall-like conditions, post tree harvest. (photo from Sagehen Test Plots 2010, emphasis area 5)

Photo 10:

Example of underburning under fall-like conditions, post tree harvest. (photo from Sagehen Test Plots 2010, emphasis area 5)

Hand Piling and Burning

After a hand or mechanical thin, residual activity fuels and some naturally occurring fuels are piled by hand into burn piles. Hand piles of fuels typically are burned under fall-like conditions, in winter months, or during periods of low fire danger.

Grapple Piling and Burning

After a mechanical thin, residual activity fuels and some naturally occurring fuels are piled by a grapple piler into burn piles. A grapple piler is typically an excavator that can pick up fuels from the ground surface, carry the material suspended from the ground, and place it in a pile for burning. Grapple piles of fuels typically are burned under fall-like conditions, in winter months, or during periods of low fire danger.

Mastication

As stated above, a masticator is a low ground pressure piece of equipment that "chews" up brush, small understory trees and downed woody fuels. Mastication does not actually remove wildland fuels from the treated area, but changes the size, continuity, and arrangement of the fuels, leading to an acceleration of decomposition rates of processed material and producing a desired change in fire behavior. Mastication changes a vertical large piece of fuel (i.e. a standing tree) into many smaller pieces of horizontal fuel. This is termed "*rearranging"* the fuels to a condition that allows the material to decompose more rapidly. Mastication can be a mechanized method of implementing a lop and scatter fire/fuels prescription. Mastication is also a Silvicultural Treatment Method – see above.

Unit-Specific Prescriptions and Treatments

Silvicultural and fire/fuels prescriptions and methods proposed for each treatment unit are displayed in Table 2.1 below.

Table 2.1 Prescription and Method Summary

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Silvicultural Rx – *see Order of Prescription Application section above*	Silvicultural Treatment Method	Fire/Fuels Rx	Fire/Fuels Treatment Method
33	118	1	4	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Pile Burn Rx	Grapple Pile Pile Burn
		4	30				
		5	28				
		6	56				
34	68	5	16	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Surface Fire Rx	Underburn
		6	47				
		7	5				
35	64	1	8	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Pile Burn Rx	Grapple Pile Pile Burn
		4	6				
		5	7				
		6	37				
		7	6				
36	101	4	18	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Pile Burn Rx	Grapple Pile Pile Burn
		5	13				
		6	56				
		7	14				
38	210	1	67	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Surface Fire Rx	Underburn
		4	7				
		5	86				
		7	50				
46	621	4	47	No Treatment	N/A	Surface Fire Rx	Underburn
		5	431	Plantation Thin	Mechanical Mastication	Lop & Scatter Surface Fire Rx	Mastication Underburn
		6	105				
		7	38				
47	33	5	33	No Treatment	N/A	Surface Fire Rx	Underburn
61	20	1	15	Variable Thin, Suppressed Cut, Dense	Hand	Pile Burn Rx Surface Fire Rx	Hand Pile Pile Burn
		2	5				

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Silvicultural Rx – *see Order of Prescription Application section above*	Silvicultural Treatment Method	Fire/Fuels Rx	Fire/Fuels Treatment Method
				Cover Area			Underburn
73	144	4	6	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Surface Fire Rx	Underburn
		5	107				
		6	27				
		7	4				
76	91	4	4	No Treatment	N/A	Surface Fire Rx	Underburn
		5	37	Plantation Thin	Mastication	Lop & Scatter Surface Fire Rx	Mastication Underburn
		6	42				
		7	8				
80	5	8	5	Aspen Restoration	Hand	Pile Burn Rx	Hand Pile Pile Burn
85	64	5	10	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Lop & Scatter	Mastication
		6	53				
		8	1	Aspen Restoration	Mechanical	N/A	N/A
87	207	5	67	Plantation Thin	Mechanical Mastication	Lop & Scatter	Mastication
		6	130				
		7	10				
89	34	4	6	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Surface Fire Rx	Underburn
		6	28				
90	40	6	40	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Surface Fire Rx	Underburn
91	9	2	9	Variable Thin, Suppressed Cut, Dense Cover Area	Hand	Pile Burn Rx	Hand Pile Pile Burn
98	63	1	43	Variable Thin, Suppressed Cut, Dense Cover Area	Hand	Pile Burn Rx	Hand Pile Pile Burn
		2	9				
		5	11				
99	67	1	7	Variable Thin, Suppressed Cut, Dense	Hand	Pile Burn Rx	Hand Pile Pile Burn
		2	4				

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Silvicultural Rx – *see Order of Prescription Application section above*	Silvicultural Treatment Method	Fire/Fuels Rx	Fire/Fuels Treatment Method
		4	11	Cover Area			
		5	37	Plantation Thin	Mastication	Lop & Scatter	Mastication
		6	8				
100	120	1	14	Variable Thin, Suppressed Cut, Dense Cover Area, Decadent Feature Enhancement	Hand	Pile Burn Rx Surface Fire Rx	Hand Pile Pile Burn Underburn
		2	19				
		4	17				
		5	46				
		6	24				
156	84	1	84	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening	Mechanical	Pile Burn Rx	Grapple Pile Pile Burn
163	82	1	29	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Pile Burn Rx Surface Fire Rx	Grapple Pile Pile Burn Underburn
		5	49				
		7	4				
213	268	1	182	Variable Thin, Legacy Tree Treatment, Suppressed Cut, Dense Cover Area, Early Seral Opening, Decadent Feature Enhancement	Mechanical	Pile Burn Rx	Grapple Pile Pile Burn
		2	11				
		4	21				
		5	18				
		6	25				
		7	11				
282	108	2	46	Variable Thin, Suppressed Cut, Dense Cover Area	Hand	Pile Burn Rx Surface Fire Rx	Hand Pile Pile Burn Underburn
		6	62				

Table 2.2 Summary of Treatment Unit and Emphasis Area Acres within Sagehen Project Area

Total Area within Project Boundary ***Acres***	**NFS Lands within Project Boundary** ***Acres***	**Total Acres within Treatment Units** ***Acres*** **(Percentage of Total Area in Project Boundary)** **(Percentage of NFS Lands in Project Boundary)**	
9,478	8,541	2,621 (28%) (31%)	
Total Acres of Each Emphasis Area within Treatment Units (Percentage of Emphasis Areas in Treatment Units)		Emphasis 1	453 (17%)
		Emphasis 2	103 (4%)
		Emphasis 4	173 (7%)
		Emphasis 5	996 (38%)
		Emphasis 6	740 (28%)
		Emphasis 7	150 (6%)
		Emphasis 8	6 (<1%)

Prescription Metrics

As shown in Table 2.1, each treatment unit includes one or more of the seven identified management emphasis areas. Application of the silvicultural and fire/fuels prescriptions described in the preceding section within a given treatment unit would be aligned with the treatment objectives previously described for each emphasis area within the unit. (Each emphasis area within a treatment unit is referred to as a subunit).

Metrics for post-treatment stand structure elements and tree species composition have been developed to guide application of the silvicultural and fire/fuels prescriptions within each emphasis area. Post-treatment stand structure elements include: (a) basal area, particularly in trees greater than 20 inches dbh, (b) canopy cover, (c) snag density, (d) large and small down woody material, (e) short snag/high stump densities, (f) dense cover areas (DCAs) and early seral openings (ESOs), and (g) prescribed surface fire behavior, as indicated by spatial extent and intensity (tree mortality). The site-specifically defined values for the metrics for each subunit are grounded in the scientific literature as well as Forest Plan direction related to emphasis area objectives. The Sagehen Project record provides detailed citations for each defined metric, and this information is available from the Truckee Ranger District.

Post-treatment metric values for each emphasis area represent a range of outcomes that would vary by subunit as prescriptions were applied within the context of the existing stand's structure and tree species composition. For example, although silvicultural and fire/fuels prescriptions for subunits 213-1 and 38-1 are designed to meet emphasis area 1 objectives, post-treatment stand conditions for subunit 213-1, which is occupied by a higher elevation mature red fir stand on a northwest-facing slope, would be different than those for subunit 38-1, which is occupied by a lower elevation mixed conifer stand on an east-facing slope.

The stand structure and species composition metrics apply at the subunit-scale. While these metrics can play out at other spatial scales (for example, microsite or landscape scales), they are meant to be

applied at the subunit-scale. The silvicultural prescriptions would be applied in the step-wise fashion (as described in the "Order of Prescription Application" section above), with variable thinning decisions regarding which trees to retain made at generally a microsite scale by field marking crews. The stand structure and species composition subunit-scale metrics would serve to limit and define the tree marking decision space. Data on the defined metrics would be gathered and assessed during the layout and tree marking phase of the project, with adjustments made to tree marking as necessary to align with emphasis area treatment objectives. This information would also be available to stakeholders and other interested individuals and groups, allowing feedback during the ongoing scoping process, with possibility of making incremental changes to the proposed action, as needed.

Detailed descriptions of each subunit's silvicultural and fire/fuels prescriptions and associated post-treatment stand structure and tree species composition metric values are included in the Sagehen Project record. These detailed descriptions in the project record provide the site-specific information that would be used to guide application of the silvicultural and fire/fuels prescriptions on the ground. The sections below summarize key similarities and differences between the metrics for each emphasis area.

Basal Area

Although site and stand-scale basal areas are relatively homogeneous, existing subunit-scale basal areas are quite variable, both within and between emphasis areas, ranging on average between 100 and 280 square feet per acre across all subunits. However, site conditions can exceed 280 square feet. Emphasis area treatment objectives would be expected to result in a 20 to 25 percent reduction in existing basal area levels at the subunit scale, with the lower end of the range (20 percent reduction) in emphasis area 1 subunits and the higher end (25 percent reduction) in emphasis area 7 subunits. Residual basal areas in emphasis areas 1 through 4 would typically range between 165 and 190 square feet per acre, but could go as high as 300 square feet in DCAs or similar existing dense areas retained in the variable thin prescription (such as groupings of large trees). While emphasis areas 5, 6, and 7 would typically range between 100 and 170 square feet per acre, there could be sites as low as 10 square feet in ESOs, and other areas that would exceed 170 square feet (such as in DCAs or similar existing dense areas retained in the variable thin prescription - groupings of large trees).

In summary, all ranges are presented as overall averages at the subunit level scale. Site-scale conditions influence the average subunit basal areas, but can be outside these ranges. Retained basal area would vary based on existing pre-treatment conditions coupled with emphasis area goals, and would contribute to the increase in site and stand variability. Mechanical thinning treatments would at minimum meet Forest Plan standards and guidelines for basal area retention (SNFPA ROD, pg. 50), and in many cases exceed retention standards.

In addition, reductions in basal area would not be evenly distributed across tree size classes (trees less than ten inches dbh, trees between ten and 19.9 inches dbh, and trees between 20 and 29.9 inches dbh), however. All trees 30 inches dbh and larger would be retained within all treatment units. For all emphasis areas, silvicultural prescriptions focus on removing selected trees less than 20 inches dbh, guided by the emphasis area's treatment objectives. The majority of the retained basal area would be in the largest trees within each subunit, and most trees 20 inches dbh and larger would be retained

following application of the silvicultural and fire/fuels prescriptions. Data from the Sagehen Test Plots show that between 89 and 93 percent of trees between 20.0 and 29.9 inches dbh were retained following application of variable thinning, legacy tree treatment, dense cover area, and early seral opening prescriptions and, in the case one unit, a low intensity surface fire prescription. Similar outcomes would be expected for the Sagehen Project subunits.

Canopy Cover

Tree canopy cover retention would result from retaining basal area as described above. Canopy cover is a stand level average that indicates roughly the percentage of the forest floor that is vertically overtopped with tree canopy. The silvicultural and fire/fuels prescriptions are expected to result in varying canopy cover levels within each subunit. For emphasis area 1 through 5 subunits, canopy cover following application of silvicultural and fire/fuels prescriptions would on average be greater than 50 percent, with reductions of existing canopy cover ranging between 10 and 15 percent. For emphasis area 6 and 7 subunits, canopy cover following application of prescriptions would generally range on average between 40 and 50 percent. However in all emphasis areas, site canopy cover could go as high as 85 percent in DCAs or similar existing dense areas retained in the variable thin prescription (such as groupings of large trees), or as low as 20 percent in ESOs.

In summary, all canopy cover ranges are presented as overall averages at the subunit level scale. Site-scale canopy cover influences the average subunit canopy cover percentages, but can be outside these ranges. Retained canopy cover would vary based on existing pre-treatment conditions coupled with emphasis area goals, and would contribute to the increase in site and stand variability. Mechanical thinning treatments would meet (and, in many cases, exceed) Forest Plan standards and guidelines for canopy cover retention (SNFPA ROD, pp. 50 – 51) and in many cases exceed retention standards.

Snag Density

Snag density levels would be higher within emphasis areas 1 through 5 compared to emphasis areas 6 and 7. Large snags (greater than 15 inches dbh) would be retained within all subunits, regardless of emphasis area. Where currently available within emphasis area 1, 2 and 5 subunits, some decadent firs with declining crown characteristics would be retained for future snag recruitment. Where existing snag levels are low, particularly within the plantations, silvicultural prescriptions retain all snags greater than three inches dbh. Snag retention would meet (and, in many cases, exceed) Forest Plan standards and guidelines (SNFPA ROD, pg. 51).

Snag density goals, especially in emphasis areas 1 and 2, would incorporate findings set forth in Spencer (1981) “Average densities (no. per ha) in known marten habitat was 46 snags (>20cm)”. This converts to 18.6 snags per acre greater than 7.9 inches dbh, however this density was in clumps, not as an average across high quality marten reproductive habitat (pers. comm. Wayne Spencer, 2011). The management recommendation from Spencer (1981) of “At least 8 snags/ha >= 38cm dbh, including at least 1 fir snag/ha 70 cm should be retained” (converted 3 snags per acre greater than or equal to 15 inches dbh, 0.4 fir snag per acre 28 inches dbh) is also incorporated into snag density goals in that all snags greater than 15 inches dbh would be retained and where snags numbers were low, snags would be created through the Decadent Feature Enhancement prescription (see below for subunits with this prescription applied). Emphasis area 1 and 2 long term objectives for snags greater than 15 inches dbh are 18 and 15

snags per acre respectively and the project goal is to move emphasis areas towards the long term objectives.

Silvicultural prescriptions for subunits 33-1, 33-5, 35-1, 35-5, 36-5, 85-5, 100-1, 100-2, 213-1, 213-2, 213-4, and 213-5 call for creating (via partial tree girdling) approximately two to three snags (each between 15 and 30 inches dbh) per acre outside DCAs and one snag (greater than 15 inches dbh) per acre within DCAs.

Hand-constructed fire lines would be placed around large snags before applying low intensity surface fire prescriptions. Each subunit's low intensity surface fire prescription (available in the project record) specifies the numbers of snags to be lined, based on existing numbers of large snags within the subunit. In emphasis area 1 and 2 subunits proposed for underburning, between 10 and 18 large snags per acre would be lined while in emphasis area 4, 5, 6, and 7 subunits, between 2 and 10 large snags per acre would be lined.

In treatment units where hand or grapple piling of fuels would be conducted, piles would be located a sufficient distance from large snags (greater than 15 inches dbh) to ensure the snags did not ignite during pile burning operations.

Down Woody Material

In all subunits, regardless of emphasis area, large down logs (larger than 15 inches diameter and ten feet long) would be retained during implementation of silvicultural treatments (mechanical thinning or mastication). Crushing of large down logs with machinery would be avoided.

Fire/fuels prescriptions are designed to retain specified levels of down woody material, commensurate with emphasis area management objectives. In units proposed for application of low intensity surface fire following silvicultural treatments, the largest down logs per acre would be lined to protect them during underburning operations. Emphasis area 1 and 2 subunits to be underburned have the greatest quantities of large down logs to be lined prior to underburning, ranging from 15 to 20 large down logs to be lined per acre. In emphasis area 4, 5, 6, and 7 subunits generally three to seven large down logs per acre would be lined, with the exception of subunits 163-5, 163-7, and 213-4. In these subunits, approximately 15 to 20 large logs per acre would be lined prior to application of low intensity surface fire.

In treatment units proposed for grapple or hand piling, piles would be located a sufficient distance from large down logs to ensure the logs did not ignite during pile burning operations. In addition, piling would not be conducted on approximately 30 percent of the unit, allowing for retention of small down woody material.

In treatment units proposed for surface fire prescriptions (Table 2.1), approximately 30 percent of each unit's area would not be underburned. Small woody material would be retained in these unburned areas of the treatment units.

Short Snags/High Stumps

Short snags would be created in emphasis area 1 through 6 subunits with silvicultural prescriptions that include existing DCAs. These subunits are located outside the Sagehen Project's plantations. To create short snags, approximately two live trees per acre of DCA, greater than 15 inches dbh, would be cut at a height of ten to 20 feet above the ground. White fir would be the preferred cut species. Felled portions of these cut trees would be retained on site.

Dense Cover Areas and Early Seral Openings

Silvicultural prescriptions call for varying acreages of DCAs and/or ESOs within each subunit, based on emphasis area. (Note that DCAs and ESOs are not included in the plantation thinning prescription.) DCA/ESO acreages are calculated as a portion of each subunit's area, with the highest proportion in emphasis area 1 subunits. In emphasis area 1 subunits, DCAs and ESOs would occupy an average of 15 to 20 percent of the subunit area; in emphasis areas 2 and 6, DCAs and ESOs would occupy an average of five to ten percent of the overall subunit area; in emphasis areas 4 and 5, DCAs and ESOs would occupy an average of ten to 15 percent of the subunit area; and in emphasis area 7, DCAs and ESOs would occupy an average of one to five percent of the subunit area. Subunits 38-1, 73-5, and 213-1 would have the highest acreages of DCAs, ten, eight, and 15 total acres, respectively.

Tree Species Composition

Site-specific objectives for tree species composition are based on existing species composition within the subunits. Relative percentages of tree species to be removed vary by crown class (dominant, codominant, subdominant, and suppressed) within each subunit, as described in detail in the Project Record. Silvicultural prescriptions for all subunits outside plantations, regardless of emphasis area, would be primarily focused on removing suppressed trees (ranging from 50 to 90 percent removal of existing suppressed trees) and some removal of subdominant trees (ranging from ten to 30 percent removal of existing subdominant trees), depending on the existing species composition within the subunit. In general, most dominant and codominant trees of all species would be retained, with some limited site-specific exceptions to provide for removal of three to ten percent of dominant/codominant white fir.

Because the plantations are predominantly comprised of Jeffrey pine, plantation thinning prescriptions are focused on retaining existing white fir and red fir as well as sugar pine and western white pines not infected with blister rust.

Prescribed Surface Fire Behavior

Two metrics are used to define targets for surface fire prescriptions: spatial extent of surface fire and intensity as indicated by the amount of tree mortality caused by surface fire. To facilitate application of surface fire prescriptions, underburning is proposed for entire treatment units (rather than individual subunits within treatment units). Hence, values for the prescribed surface fire metrics are applied at the treatment unit scale, and are the same for all emphasis areas.

The spatial extent for application of low intensity surface fire is approximately 70 percent of the area in a mosaic pattern within each treatment unit. (Table 2.1 above displays the treatment units proposed for surface fire prescriptions.) Approximately 30 percent of the unit's area would remain in an unburned condition. Surface fire prescriptions would be designed to result in mortality of approximately 70

percent of trees less than three inches dbh and approximately five to 15 percent of trees greater than three inches dbh. Mortality in trees greater than three inches dbh would be primarily comprised of trees in subdominant crown classes, with occasional mortality of trees in the codominant crown class.

Road Management

Previously existing Forest Service maintained and county roads within and adjacent to the project area will be used for transportation of equipment and hauling of timber. Alternative 1 includes approximately 3.8 miles of temporary road construction. Final temporary road locations will consider hydrology, slope, soil, and sensitive area restrictions, and will be located in the best available sites that minimize effects to resources.

Restoration of Existing Forest Development Roads

Site-specific watershed improvement needs, typically associated with roads needed to access the units, were identified in some treatment areas. Specific areas of road obliteration (decommissioning) would restore/improve watershed condition. This would be accomplished by re-establishing hydrologic connectivity and reducing current or potential sources of sediment. Specific actions are described below and shown on the map of Alternative 1 (Appendix B) as road obliteration.

Road 11-5, Action 1: Approximately one mile of this road would be obliterated following its use for vegetation treatment activities. Currently this road is choked with vegetation and is not accessible through much of its length. This road would be reopened to access and treat units 85 and 87 for approximately one mile. Upon completion of the treatments in these units, this segment of road would be obliterated. Road obliteration would consist of re-contouring the roadbed to a hydrologically neutral state. This also includes emphasizing protection and neutral landscape configuration above fens, designing drainage to match natural patterns, reducing compaction (sub-soiling), blocking the closed portions from future access, and mulching or otherwise providing slash and soil organic matter to control erosion.

Road 11-5, Action 2: On the section of road 11-5 below the obliteration work described in Action 1 above, where the road crosses through a fen and aspen stand, the road and its associated culvert system would be removed and full restoration measures would be implemented. The existing elevation of the culvert is placed subgrade, such that the water in the fen is draining at an accelerated rate and resulting in an ongoing reduction in fen size. Restoration measures would include filling the culvert alignment and reshaping the roadbed to support the function and hydrology of the fen (currently approximately 1.2 acres). Revegetation activities would be implemented and may include local seed and/or small plugs of sedge mat or other local vegetation obtained adjacent to the fen. Mulching would be provided as needed to control erosion and stabilize the site. This action, in combination with the proposed aspen restoration prescription in subunit 85-8 and the above described road obliteration, would restore fen and wetland hydrology and the area surrounding the fen could be improved over approximately three acres.

Change in Maintenance Level for Road 11-6

Existing Forest Development Road 11-6 is proposed to be changed from Forest Service Maintenance Level 1 to Maintenance Level 2. Maintenance Level 1 roads are typically managed for intermittent, project-related use; whereas Level 2 roads are typically managed for seasonal public and administrative use. The proposed change in road maintenance levels is an administrative change which would more accurately reflect the current conditions on the ground and the existing use that is occurring on the 11-6 road. No changes to the physical environment of the 11-6 road beyond maintenance of existing conditions are proposed in this undertaking.

Alternative 2: No Action

Under Alternative 2, No Action, none of the activities proposed under Alternative 1 or Alternative 3 would be implemented. Selection of the No Action alternative by the Responsible Officials would not preclude activities that have already been approved in this area or those being planned as separate projects.

Alternative 3: Non-commercial Funding

Alternative 3 was developed in accordance with Eastern District Court Judge England's November 4, 2009 order for Case 2:05-cv-00205-MCE-GGH. The order requires the Forest Service to analyze a non-commercial funding alternative in detail for all new fuel reduction projects not already evaluated and approved as of November 4, 2009. To develop this alternative, the proposed treatment areas were revisited to determine (a) if a beneficial fuel treatment was possible and (b) what those treatments would be. See Appendix B for a map of Alternative 3.

A total of 1,132 acres were considered for non-commercial treatments. All units were not considered to be treated under this alternative because the cost would have been too great. Therefore, in order to reduce implementation costs to around one million dollars, the most critical units were chosen for treatment (including fuels only prescriptions on all units would have cost close to twice that amount). The treatments identified only partially meet the purpose and need by addressing hazardous surface and ladder fuels. The following actions are proposed under Alternative 3 (Table 2.3) and are displayed on the map of Alternative 3 in Appendix B. Note that while emphasis areas are displayed here, there are no project goals specifically tied to each emphasis area in Alternative 3 as there are in Alternative 1. The emphasis areas are displayed solely to provide a consistent way to compare the alternatives.

Table 2.3: Summary of Alternative 3 by Treatment Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Silvicultural Rx – *see Order of Prescription Application section above*	Silvicultural Treatment Method	Fire/Fuels Rx	Fire/Fuels Treatment Method
33	118	1	4	No Treatment	N/A	No Treatment	N/A
		4	30				
		5	28				

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Silvicultural Rx – *see Order of Prescription Application section above*	Silvicultural Treatment Method	Fire/Fuels Rx	Fire/Fuels Treatment Method
		6	56				
34	68	5	16	No Treatment	N/A	No Treatment	N/A
		6	47				
		7	5				
35	64	1	8	No Treatment	N/A	No Treatment	N/A
		4	6				
		5	7				
		6	37				
		7	6				
36	101	4	18	No Treatment	N/A	No Treatment	N/A
		5	13				
		6	56				
		7	14				
38	210	1	67	No Treatment	N/A	No Treatment	N/A
		4	7				
		5	86				
		7	50				
46	621	4	47	No Treatment	N/A	Surface Fire Rx	Underburn
		5	431	Plantation Thin	Mechanical Mastication	Lop & Scatter Surface Fire Rx	Mastication Underburn
		6	105				
		7	38				
47	33	5	33	No Treatment	N/A	Surface Fire Rx	Underburn
61	20	1	15	Suppressed Cut	Hand Thinning	Pile Burn Rx Surface Fire Rx	Hand Pile Pile Burn Underburn
		2	5				
73	144	4	6	No Treatment	N/A	No Treatment	N/A
		5	107				
		6	27				
		7	4				
76	91	4	4	No Treatment	N/A	Surface Fire Rx	Underburn
		5	37	Plantation Thin	Mechanical Mastication	Lop & Scatter Surface Fire Rx	Mastication Underburn
		6	42				
		7	8				
80	5	8	5	No Treatment	N/A	No Treatment	N/A
85	64	5	10	No Treatment	N/A	No Treatment	N/A
		6	53				
		8	1	No Treatment	N/A	No Treatment	N/A
87	207	5	67	No Treatment	N/A	No Treatment	N/A
		6	130				

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Silvicultural Rx – *see Order of Prescription Application section above*	Silvicultural Treatment Method	Fire/Fuels Rx	Fire/Fuels Treatment Method
		7	10				
89	34	4	6	No Treatment	N/A	No Treatment	N/A
		6	28				
90	40	6	40	No Treatment	N/A	No Treatment	N/A
91	9	2	9	Suppressed Cut	Hand Thinning	Pile Burn Rx	Hand Pile Pile Burn
98	63	1	43	Suppressed Cut	Hand Thinning	Pile Burn Rx	Hand Pile Pile Burn
		2	9				
		5	11				
99	67	1	7	Suppressed Cut	Hand Thinning	Pile Burn Rx	Hand Pile Pile Burn
		2	4				
		4	11				
		5	37	Plantation Thin	Mechanical Mastication	Lop & Scatter	Mastication
		6	8				
100	120	1	14	Suppressed Cut	Hand Thinning	Pile Burn Rx Surface Fire Rx	Hand Pile Pile Burn Underburn
		2	19				
		4	17				
		5	46				
		6	24				
156	84	1	84	No Treatment	N/A	No Treatment	N/A
163	82	1	29	No Treatment	N/A	No Treatment	N/A
		5	49				
		7	4				
213	268	1	182	No Treatment	N/A	No Treatment	N/A
		2	11				
		4	21				
		5	18				
		6	25				
		7	11				
282	108	2	46	Suppressed Cut	Hand Thinning	Pile Burn Rx Surface Fire Rx	Hand Pile Pile Burn Underburn
		6	62				

Prescription and Treatment Method Definitions (associated treatment areas):

Silvicultural Prescriptions

Suppressed Cut

Units: 61, 91, 98, 100, 282 (all emphasis areas), 99 - emphasis areas 1, 2, and 4.

A suppressed tree is typically no larger than ten inches dbh (usually ranging between one and five inches dbh) *and* is a component of a stand's understory, where there is an overstory of dominant, codominant, and subdominant trees. Suppressed trees, in general, have little capacity to release (initiate increased growth rates), even if the overstory is removed. These trees often make up the lower levels of ladder fuels, and the suppressed tree layer combined with subdominant trees helps connect the forest floor into the crowns of dominant/codominant trees, which can increase fire severity and the potential for crown fire.

The suppressed cut would remove suppressed trees (down to one inch dbh for hand thinning and down to three inches dbh for mechanical thinning). Suppressed tree removal would facilitate use of prescribed fire while helping to minimize the risks of crown fire by removing some ladder fuels.

Although the suppressed cut prescription is proposed to remove the majority of trees less than ten inches dbh in the units proposed for treatment, the limited treatment in emphasis area 4 of the plantation thinning prescription (see below) and the remainder of the units not proposed for treatment will more than meet Forest Plan requirements of retaining at least five percent of trees between six and 24 inches dbh within the overall project area.

Plantation Thinning

Units: 46- emphasis areas 5, 6, and 7, 76- emphasis areas 5, 6, and 7, and 99- emphasis areas 5 and 6.

Plantations in the Sagehen Project Area were established in the 1960s and 1970s following the Independence and Donner Ridge wildfires. The plantations are largely comprised of planted Jeffrey and ponderosa pines; however, they also contain young trees that grew in naturally. The plantation thinning prescription is designed to facilitate and accelerate the continued growth of these young trees. The plantations currently contain some trees that survived wildfire and subsequent salvage harvest: these "residual" trees would not be removed. While they do meet the definition of legacy trees, residual trees in plantations would be treated differently than individual or small groups of legacy trees with a focus on removing ladder fuels to protect them during prescribed burning treatments. There also would be an emphasis on removing ladder fuels on the downhill sides of the residual trees where steep slopes may contribute to flame lengths reaching the residual trees.

Plantation thinning would involve mechanical thinning and/or mastication (mechanical grinding and crushing that *rearranges* material on site) of plantation trees and mastication of brush. Mastication changes a vertical large piece of fuel (i.e. a standing tree) into many smaller pieces of horizontal fuel. This is termed "*rearranging"* the fuels to a condition that allows the material to decompose more rapidly. The plantation thinning prescription would primarily focus on removing and/or rearranging trees between one and 12 inches dbh. An occasional tree between 12 and 18 inches dbh could be removed; however, this would occur only where mechanical cutting and removal systems were used. The majority of trees between 12 and 18 inches dbh would be retained. Because of the nature of plantations and the logistics of marking trees in extremely dense brush, trees would be thinned by description and a spacing guideline would be applied. Typically, retained trees would be spaced roughly

14 to 22 feet apart. Plantation thinning would retain at least 120 trees per acre. Sufficient tree canopy cover would be maintained to suppress shrub growth under groups of trees; however, retarding shrub growth over the entire treatment unit would not be a specific objective.

Shrubs growing under the drip line of retained trees would be masticated. Other areas of snow brush, manzanita, and white thorn outside the drip lines would also be masticated to decrease the fire hazard and provide opportunities for brush regeneration. Further, patches of bitterbrush and *Ribes* outside of tree drip lines would not be masticated unless they posed a fire hazard (ladder fuels) to retained trees/groups of trees. Bitterbrush is a preferred browse species for mule deer and it occurs in some homogeneous small patches in the plantations. These patches provide valuable foraging habitat. Because bitterbrush and *Ribes* do not regenerate (stump sprout) very well after mastication, unless posing a direct ladder fuels hazard, these species would not be masticated.

In addition to spacing guideline ranges, other measures would be implemented to increase within-stand horizontal heterogeneity. Where less than ten trees per acre are present, no trees would be thinned and shrubs would not be masticated; however, these areas could be underburned. Because the plantations are largely composed of Jeffrey and ponderosa pines, species preference for retention would focus on other species, if they are present. This could mean that a larger pine would be proposed for removal/mastication if it is in close proximity to a tree of another species, such as red fir.

Identified drainage bottoms within plantations would not be treated. Based on existing conditions in the plantation treatment units, it is estimated that at least ten percent of the overall plantation acreage would be included in these residual tree zones, sparsely treed areas, and drainages. These areas would enhance heterogeneity in the treated plantations.

Silvicultural Treatment Methods

Mechanical Thinning

Units: 46- emphasis areas 5, 6, 7, 76- emphasis areas 5, 6, and 7, 99- emphasis areas 5 and 6.
Mechanical thinning is a harvest activity, which, under the Sagehen Project would utilize ground-based equipment (tractors, feller bunchers and some chainsaw work) to fell and remove identified trees while retaining and protecting desirable trees to accomplish fuels reduction objectives. A network of skid trails (in the case of ground-based thinning operations), landings, and, in some cases, temporary roads (which are removed following project activities) would be used to transport and collect harvested material. This equipment would operate on slopes generally less than 25 percent. Short pitches less than 150 feet long and up to 30 percent in slope would also be included in treatments using ground based equipment. A borate compound would be applied to all white fir stumps greater than 14 inches in diameter to prevent Annosus root disease.

Hand Thinning

Units: 61, 91, 98, 100, 282 (all emphasis areas), 99 - emphasis areas 1, 2, and 4.

Hand thinning is an activity that utilizes crews with chainsaws or handsaws that cut understory conifers less than 16 inches dbh to accomplish fuels reduction objectives. If hand felled material contributes to

unacceptable fuel loading, this material may be hand piled outside the drip lines of desirable trees and burned when conditions permit a minimum amount of mortality.

Mastication

Units: 46 - emphasis areas 5, 6, and 7, 76- emphasis areas 5, 6, and 7, 99- emphasis areas 5 and 6.

A masticator is a low ground pressure piece of equipment that "chews" up brush and small understory trees to reduce competition. The machine mechanically grinds and crushes this material and down woody fuels and distributes the resulting small pieces around the site. This equipment would operate on slopes generally less than 25 percent. Short pitches less than 150 feet long and up to 30 percent in slope would also be included in treatments using ground based equipment. Mastication is also a Fire/Fuels Treatment Method – see below.

Fire/Fuels Prescriptions

Surface Fire Prescription

Units: 46, 47, 61, 76, 100, 282 (all emphasis areas).

A surface fire is a fire that burns live and dead fuels at or near the surface of the ground, mostly by flaming combustion. A surface fire prescription is usually implemented by an underburn. Surface fire prescriptions are typically designed to consume surface and ladder fuels and to mimic fire that would occur in an active fire regime. Surface fire prescriptions can be applied under spring-like and fall-like conditions. Spring-like conditions are defined by relatively high live fuel moistures, high 1000 hour size ("coarse woody debris", three inches diameter and greater) fuel moistures, and soils that are relatively moist beneath the surface fuels. Under spring-like conditions, it is expected that surface fires would have moderate to high consumption of 1-100 hour size fuels ("fine woody debris", ranging from 0.00-2.99 inches diameter) and minimal consumption of 1000+ hour fuels with mortality primarily expected in subdominant tree size classes. Fall-like conditions are defined by relatively low live fuel moistures, lower 1000 hour fuel moistures, and drier soils with dry organic layers beneath the litter layer. Under fall-like conditions, it is expected that burning would be primarily surface fires with higher flame lengths, and faster burn times as compared to burning under spring-like conditions. It would have high consumption of 1-100 hour size fuels and moderate to high consumption of 1000+ hour fuels, and with mortality expected in subdominant and some codominant tree size classes. Depending on cycles of drought and wet weather, spring-like and fall-like conditions can occur throughout the year. For the Sagehen Project, spring-like condition surface fire prescriptions would be emphasized, however due to limited suitable burning conditions, surface fire prescriptions under fall-like conditions would be implemented in some cases.

Pile Burn Prescription

Units: 61, 91, 98, 100, 282 (all emphasis areas), 99 - emphasis areas 1, 2, and 4.

A pile burn prescription is designed to remove surface fuels, both fuels generated from silvicultural treatments (activity fuels) and existing fuels on the ground. A pile burn prescription can be implemented by hand or by machinery. In general, small down wood is placed in piles for future burning. Pile location and size is dictated by existing conditions, however piles would be preferentially placed outside of

sensitive areas such as riparian conservation areas and cultural resource sites. Piles of fuels typically are burned under fall-like conditions, in winter months, or during periods of low fire danger. This prescription removes surface fuels in the treatment units and is used to mimic underburning where sensitive areas prevent unit-wide application of underburning.

Lop and Scatter

Units: 46 - emphasis areas 5, 6, and 7, 76 - emphasis areas 5, 6, and 7, 99 - emphasis areas 5 and 6.

A lop and scatter prescription does not remove fuels from treated areas. It prescribes changing the size and arrangement of the fuels. Lop and scatter prescriptions usually deal with activity generated fuels as a result of tree removal (tree tops and branches), however it can also apply to brush and standing ladder fuels. The purpose of a lop and scatter prescription, by changing the arrangement and size of fuels, is to take the fuels to a condition that allows the material to break down more rapidly.

Fire/Fuels Treatment Methods

Underburning

Units: 46, 47, 61, 76, 100, 282 (all emphasis areas).

Underburning is a generalized term used when applying prescribed fire to large areas and is typically the treatment method for a surface fire prescription. Underburning targets surface fuels, some understory, and, in rare cases, larger trees. Surface fuels are the primary agent of fire spread. The objective is to apply controlled fire under optimum conditions where the treatment can modify fuel conditions to effectively reduce fire behavior and the corresponding intensity of a future wildfire. Within some areas proposed for burning, the goal of the treatment may be to consume a significant portion of the existing surface fuels that could cause high wildfire intensities, and/or the consume understory vegetation (ladder fuels) in order to reduce future fire severity and to create conditions that allow for future prescribed underburning opportunities. In other areas, underburning is used to create new growth of native shrub species and forage opportunities for wildlife. Underburning most closely mimics low-intensity fire that would occur in an active fire regime. Underburning, especially on south and west facing slopes, is typically conducted under spring-like conditions. A more mosaic burn pattern is created by underburning in spring-like conditions as compared to fall-like conditions; with some areas minimally burned and overall less fuel consumption. For the Sagehen Project proposal, underburning would be applied on a unit-wide basis, in other words, where underburning is proposed it would be conducted across the entire treatment unit and across all subunits (emphasis areas) within that treatment unit.

Hand Piling and Burning

Units: 61, 91, 98, 100, 282 (all emphasis areas), 99 - emphasis areas 1, 2, and 4.

After a hand or mechanical thin, residual activity fuels and some naturally occurring fuels are piled by hand into burn piles. Hand piles of fuels typically are burned under fall-like conditions, in winter months, or during periods of low fire danger.

Mastication

Units: 46 - emphasis areas 5, 6, and 7, 76 - emphasis areas 5, 6, and 7, 99 - emphasis areas 5 and 6.

As stated above, a masticator is a low ground pressure piece of equipment that "chews" up brush, small understory trees and downed woody fuels. Mastication does not actually remove wildland fuels from the treated area, but changes the size, continuity, and arrangement of the fuels, leading to an acceleration of decomposition rates of processed material and producing a desired change in fire behavior. Mastication changes a vertical large piece of fuel (i.e. a standing tree) into many smaller pieces of horizontal fuel. This is termed "rearranging" the fuels to a condition that allows the material to decompose more rapidly. Mastication can be a mechanized method of implementing a lop and scatter fire/fuels prescription. This equipment would operate on slopes generally less than 25 percent. Short pitches less than 150 feet long and up to 30 percent in slope would also be included in treatments using ground based equipment. Mastication is also a Silvicultural Treatment Method – see above.

Road Management

Change in Maintenance Level for Road 11-6

Existing Forest Development Road 11-6 is proposed to be changed from Forest Service Maintenance Level 1 to Maintenance Level 2. Maintenance Level 1 roads are typically managed for intermittent, project-related use; whereas Level 2 roads are typically open for seasonal public and administrative use. The proposed change in road maintenance levels is an administrative change which would more accurately reflect the current conditions on the ground and the existing use that is occurring on the 11-6 road. No changes to the physical environment of the 11-6 road beyond maintenance of existing conditions are proposed in this undertaking.

Standard Management Requirements

Standard Management Requirements (SMRs) have been developed by the Sagehen Project's interdisciplinary team to avoid or reduce potential adverse environmental effects under both Action Alternatives (Alternative 1 and Alternative 3). SMRs are not needed under Alternative 2, as no actions are proposed under that alternative. The SMRs help the Sagehen Project meet applicable Forest Plan standards and guidelines and other regulatory requirements. Some of the SMRs would not apply to Alternative 3 (i.e. landing placement and skid trail utilization) because of its non-commercial nature and smaller scope of activities. A complete list of the SMRs indexed by applicable resource values is incorporated into this EA as Appendix A. Appendix A will be referenced throughout the EA in discussions concerning specific SMRs.

Monitoring

The Sagehen Project Alternatives 1 and 3 require implementation monitoring of Best Management Practices (BMPs) and Standard Management Requirements (SMRs) throughout the life of the project. This ensures all BMPs and SMRs outlined in the project are followed. Each discipline has the delegated responsibility and associated funding to monitor their specific resource and ascertain whether treatments are following project requirements. Further, treatments are monitored for unforeseen effects, which help inform the project's adaptive management strategy. In addition, for Alternative 1, further monitoring would occur as described below:

A. NE Sagehen Goshawk PAC Monitoring

Pre-treatment, full protocol surveys of existing suitable goshawk habitat in the Sagehen Project Area were conducted in 2004 – 2005. Full protocol surveys of suitable goshawk habitat commenced again in 2012 and will be completed in 2013. In addition, known goshawk PACs in the Sagehen Project Area have been monitored in 2006, and 2009-2013.

In 2011, a new, active goshawk nest with one fledgling was discovered, necessitating the designation of NE Sagehen Goshawk PAC. Under Alternative 1, a portion of this PAC is proposed for mechanical thinning followed by prescribed underburning. This PAC has been continuously monitored for occupancy since 2011, and would be monitored to protocol for 2 years following the proposed mechanical treatment. If this PAC was found to be unoccupied after the first year's survey, suitable goshawk habitat within the Sagehen Basin north of Sagehen Creek would be monitored the following year to assess goshawk presence.

B. Key Habitat Feature Monitoring

The Sagehen Project proposes a number of prescriptions that are designed to create, protect, and maintain specific habitat features that are particularly important for late seral species, including the Pacific marten and northern goshawk. The metrics for these habitat features are based upon levels described in relevant literature as desirable and as negotiated through the Sagehen collaborative process. The Sagehen Project's prescriptions are designed to meet the Project's identified need for "maintaining and enhancing habitat for the marten and other wildlife species associated with late seral forest habitat." Each phase of Sagehen Project implementation would have checks installed to ensure the desired numbers and configurations of habitat features existed after the implementation was complete. Monitoring for each feature type is outlined below:

Decadent feature enhancement:

- All decadent features to be created have been marked with white paint, which will make them identifiable during contract and force account implementation.
- All features have been mapped and accounted for in GIS and are available in the project geodatabase.
- The complete, spatial pre-treatment data set would translate into contract specifications and ensure accurate administration.
- Created features would be monitored during any force account burning. Additional protections during underburning, such as lining or suppression, would be implemented if there were undesirable levels of feature consumption.

Dense cover areas:

- All features have been mapped and accounted for in GIS and are available in the project geodatabase.
- All areas that will be maintained as DCAs have been designated with flagging to facilitate their identification during contract and force account implementation. Since DCAs have been GPS mapped, if flagging was lost, these areas would be redesignated with GPS

hardware. Potential contractor GPS capabilities would also aid in protection from machine encroachment.

- The complete, spatial data set would translate into contract specifications and ensure accurate administration.
- Although some DCAs could have some associated prescribed burning, only moderate amounts of mortality would be accepted. Therefore, the fuels specialist would incorporate lighting requirements in and around dense cover areas into the burn plan to minimize fire intensities. The burn boss would monitor fire movement throughout the units and ensure that DCA mortalities were limited. Additional protections during prescribed burning, such as lining or suppression, would be implemented if there were undesirable levels of feature consumption.

Existing larger down logs:

- All down logs greater than 15 inches diameter and 10 feet long would be retained during contract and force account implementation. However, a small percentage could be compromised during mechanical work or accidentally consumed during extended burning phases of the prescribed fire in units where these methods are prescribed. If more than one of these larger down logs for every five acres of unit was compromised, tactics would be halted and reevaluated before continuing.
- Contract specifications would be clear and enforceable in order to minimize effects on larger down wood populations within units.
- Features believed to be vulnerable to consumption during prescribed burning would be lined before ignition.
- The fuels specialist would incorporate lining requirements into the burn plan. The burn boss would monitor fire movement throughout unit to ensure that the majority of larger down logs remained intact.

Existing larger snags:

- All snags greater than 15 inches diameter at breast height (dbh) would be retained during contract and force account implementation. However, a small percentage could be knocked down during mechanical work or accidentally consumed during extended burning phases of the prescribed fire in units where these methods are prescribed. If more than one of these larger snags for every five acres of unit was compromised, tactics would be halted and reevaluated before continuing.
- Contract specifications would be clear and enforceable in order to minimize effects on larger snag populations within units.
- Features believed to be vulnerable to consumption during prescribed burning would be lined before ignition.
- The fuels specialist would incorporate lining requirements into the burn plan. The burn boss would monitor fire movement throughout unit to ensure that the majority of larger snags remained intact.

The Sagehen Project also provides a unique opportunity to study project effects through an array of sound study designs coupled with a rich baseline of data from several external partners. These studies may produce some of the most thorough effects monitoring on forest management projects up to date. There are numerous ongoing studies within the Sagehen Basin that, in some cases, can be modified or simply repeated, to monitor project effects. Studies that have been tied to Sagehen Project implementation include the Calhoun line trapping transects that began in the 1950s and are currently being revisited by PSW researcher Pat Manley. Researcher Marty Raphael is revisiting bird survey plots begun in the 1960s within the 1960 Donner Ridge fire. The Monitoring Avian Productivity and Survivorship (MAPS) project runs annual bird banding stations at sites within the basin. Starting in the early 2000s, scientists from the University of California (John Battles and Scott Stephens) developed a research approach and gathered a massive dataset derived from over 500 plots and LiDAR imaging which informed fine scale vegetative and fuel conditions within the basin to examine the effects of strategically placed area treatments (SPLATs). Annual fish monitoring continues in various Sagehen Creek stretches based on Starker Leopold's work in the 1950s. American marten population studies were performed in the early 1980s as well as recently by Katie Moriarty. The USGS regularly samples Sagehen Creek water chemistry and remotely monitors flow. Terry Hogue is evaluating stream water yield while researcher Jim Kirchner is evaluating weather, groundwater and sap flow patterns. Finally, the National Atmospheric Deposition Program has ongoing precipitation sampling from 12 weather towers within the basin.

The Pacific Southwest Research Station (PSW) and the Tahoe National Forest (TNF) agree, in principle, to collaborate on post-treatment monitoring, with design lead from PSW, that includes assessing the occupancy status of existing goshawk PACs and conducting a marten survey during the summer and winter after the final unit is treated. The relative contributions of personnel and funding from PSW and the TNF would be determined and negotiated at a later date. We recognize the importance of species monitoring following treatments, and we commit to explore and attempt to secure sources of funding for this work. Finally, using collaborative expertise from both branches of the Agency and to the extent funding allows, we would track the amount and distribution of predicted high quality habitat for marten in the Sagehen Basin over time and provide for a Basin-wide analysis of the connectivity of predicted high quality marten habitat. The potential scientific value of effects monitoring is maximized under Alternative 1, compared with the other alternatives, given this alternative's innovative design of treatment prescriptions aimed at achieving ecological restoration goals. Alternative 3 was not designed to achieve ecological restoration goals, while Alternative 2 maintains existing trends.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. The alternatives can be compared in terms of (a) how well they respond to the purpose and need for action and (b) their environmental effects. Tables 2.4 and 2.5 below provide a comparison of the alternatives in these two regards. Information in the tables is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives. Detailed analyses for the environmental effects summarized in Table 2.5 are provided in Chapter 3 of this EA.

Table 2.4. Comparison of Sagehen Project alternatives in terms of meeting the purpose of and need for action.

Purpose and Need for Project	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3 (Non-commercial Funding Alternative)
Reduce hazardous fuel loadings and modify landscape scale wildland fire behavior	Reduces hazardous fuel loadings across 2,621 acres with mechanical, manual and prescribed fire vegetation treatments. Reduced fuel loading and strategic placement of the treatment units and prescriptions throughout the project area would reduce wildland fire intensity and modify landscape scale wildland fire behavior.	No vegetation treatments are proposed. Does not reduce hazardous fuel loadings or modify landscape scale wildland fire behavior.	Reduces hazardous fuel loadings across 1,132 acres with mechanical, manual and prescribed fire vegetation treatments. The treatments are concentrated around Sagehen Field Station for protection of improvements. Wildland fire intensity would be less in treated areas, but would remain high in untreated areas. Insufficient acres are treated under this alternative to modify landscape scale fire behavior.
Maintain and enhance habitat for the marten and other wildlife species associated with late seral forest habitat	Project design features in the form of emphasis area treatment prescriptions, dense cover areas, and early seral openings both maintain and enhance habitat for the marten and other late seral forest species across the project area.	No vegetation treatments are proposed. Maintains current habitat conditions and trends, but does not enhance habitat for marten and other late seral forest species.	Placement of vegetation treatments avoids high quality habitat for marten and other late seral forest species. Habitat for these species is maintained.
Create heterogeneous forest stand conditions that would be expected to develop under an active fire regime	Project design features in the form of emphasis area treatment prescriptions, dense cover areas and early seral openings mimic forest stand conditions that would be expected to develop under an active fire regime.	No vegetation treatments are proposed. Heterogeneous forest stand conditions expected under an active fire regime are not created.	Vegetation treatments are designed for hazardous fuels reduction objectives only. Heterogeneous forest stand conditions expected under an active fire regime are not created.
Enhance the ecological role of fire	Mechanical and manual vegetation treatments across 2,621 acres would help reduce the intensity of future wildland fires, maximizing ecological benefits and minimizing risk of stand replacing crown fires. Fire is re-	No prescribed burning or other vegetation treatments are proposed. The ecological role of fire would not be enhanced by prescribed burning or other vegetation treatments. The risk of a stand replacing crown fire	Mechanical and manual vegetation treatments across 1,132 acres would help reduce the intensity of future wildland fire in treated units and help protect Sagehen Field Station, but would not substantially alter

Purpose and Need for Project	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3 (Non-commercial Funding Alternative)
	introduced into the ecosystem within the project area with approximately 2,350 acres treated with prescribed burning.	would remain high.	landscape scale fire behavior because not enough acres are treated. Risk of stand replacing crown fires remains high in the project area. Fire is re-introduced into the ecosystem on a smaller scale than under Alternative 1 with approximately 1,087 acres treated with prescribed burning. This alternative was not designed to enhance the ecological role of fire.
Implement vegetation and fuels management actions congruent with GTR 220 recommendations.	Yes	No	No
Implement fuels treatment strategy for Sagehen Basin delineated in UC Berkeley study (2007).	Yes	No	No
Test innovative forest management practices in an Experimental Forest setting.	Yes	No	No

Table 2.5 Comparison of Sagehen Project alternatives in terms of potential environmental effects.

Potential Effects	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3 (Non-commercial Funding Alternative)
Pacific marten and habitat	Suitable marten habitat: Approximately 775 acres (231 acres high quality, 544 acres moderate quality) suitable marten habitat proposed for thinning and fuels treatments, resulting in short-term reduction in habitat quality. Forest resiliency, habitat diversity, and fuels	Suitable marten habitat: No suitable high and moderate quality marten habitat is proposed for treatments. Existing habitat conditions would remain. Forest resiliency, habitat diversity, and fuels reduction: Alternative 2 would not strive to achieve forest resiliency or	Suitable marten habitat: Approximately 222 acres (146acres high quality, 76 acres moderate quality) suitable marten habitat proposed for hand thinning fuels treatments, resulting in short-term reduction in habitat quality. Forest resiliency, habitat diversity, and fuels

Potential Effects	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3 (Non-commercial Funding Alternative)
	reduction: When compared to Alternatives 2 and 3, Alternative 1 would strive to achieve the greatest amount of forest resiliency and improvement of forest structural wildlife habitat diversity while reducing the risk of marten habitat loss to stand-replacing wildfire compared to Alternatives 2 and 3.	improvement of forest structural diversity for wildlife. Would not reduce the risk of marten habitat loss to stand-replacing wildfires.	reduction: When compared to Alternative 1, would strive to achieve fewer acres of forest resiliency and improvement of forest structural wildlife habitat diversity while reducing the risk of marten habitat loss to stand-replacing wildfire.
California spotted owl and habitat	Protected Activity Center (PAC): No treatments proposed with PAC. Home Range Core Area (HRCA): Proposed mechanical thinning/fuels treatments and hand thinning on 234 acres of suitable foraging habitat within HRCA, resulting in short-term reduction in habitat quality. No suitable nesting habitat would be treated or affected. Suitable Habitat within Project Area: No nesting habitat would be affected by proposed treatments. Approximately, 1,280 acres foraging habitat would be thinned, resulting in short-term reduction in canopy cover and habitat quality. Forest resiliency, habitat diversity, and fuels reduction: When compared to Alternatives 2 and 3, Alternative 1 would strive to achieve the greatest amount of forest resiliency and	Protected Activity Center (PAC): No treatments proposed with PAC. Home Range Core Area (HRCA): No foraging habitat would be affected within HRCA. Existing habitat conditions would remain. Suitable Habitat within Project Area: No treatments would occur within suitable nesting for foraging habitat. Existing habitat conditions would remain. Forest resiliency, habitat diversity, and fuels reduction: Would not strive to achieve forest resiliency or improvement of forest structural diversity for wildlife. Would not reduce the risk of spotted owl habitat loss to stand-replacing wildfires.	Protected Activity Center (PAC): No treatments proposed with PAC. Home Range Core Area (HRCA): No mechanical thinning treatments proposed. Hand thinning treatments would occur on 20 acres of suitable foraging habitat within HRCA, resulting in short-term reduction in habitat quality. Suitable Habitat within Project Area: No nesting habitat would be affected by proposed treatments. Approximately, 112 acres foraging habitat would be thinned, resulting in short-term reduction in canopy cover and habitat quality. Forest resiliency, habitat diversity, and fuels reduction: When compared to Alternative 1, Alternative 3 would strive to achieve forest resiliency and improvement of forest structural wildlife habitat diversity on fewer acres while reducing the risk of spotted owl habitat

Potential Effects	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3 (Non-commercial Funding Alternative)
	improvement of forest structural wildlife habitat diversity while reducing the risk of spotted owl habitat loss to stand-replacing wildfire.		loss to stand-replacing wildfire.
Northern goshawk and habitat	Goshawk PACs: Approximately 56 acres proposed for hand thinning within the **Lower Sagehen PAC**, resulting in short-term reduction in canopy cover and habitat quality. Non-significant Plan Amendment proposed for treatment on 139 acres within the **NE Sagehen PAC**, resulting in short-term reduction in canopy cover and habitat quality. Suitable Habitat within Project Area: Approximately 2,590 acres (1,792 nesting, 798 foraging) suitable goshawk habitat proposed for treatment resulting in short-term reduction in canopy cover and habitat quality. Forest resiliency, habitat diversity, and fuels reduction: When compared to Alternatives 2 and 3, Alternative 1 would strive to achieve the greatest amount of forest resiliency and improvement of forest structural wildlife habitat diversity while reducing the risk of spotted owl habitat loss to stand-replacing wildfire.	Goshawk PACs: No treatments proposed within PACs. Existing habitat conditions would remain. Suitable Habitat within Project Area: No suitable nesting and foraging goshawk habitat proposed for treatment. Forest resiliency, habitat diversity, and fuels reduction: Would not achieve forest resiliency or improvement of forest structural diversity for wildlife. Would not reduce the risk of goshawk habitat loss to stand-replacing wildfires.	Goshawk PACs: Approximately 56 acres proposed for hand thinning within the **Lower Sagehen PAC**, resulting in short-term reduction in canopy cover and habitat quality. Suitable Habitat within Project Area: Approximately 1,095 acres (703 nesting, 391 foraging) suitable goshawk habitat proposed for treatment resulting in short-term reduction in canopy cover and habitat quality. Forest resiliency, habitat diversity, and fuels reduction: When compared to Alternative 1, Alternative 3 would strive to achieve fewer acres of forest resiliency and improvement of forest structural wildlife habitat diversity on fewer acres while reducing the risk of goshawk habitat loss to stand-replacing wildfire.
Water quality	Mechanical treatments		Mechanical treatments

Potential Effects	Alternative 1 (Proposed Action)	Alternative 2 (No Action)	Alternative 3 (Non-commercial Funding Alternative)
	would be conducted on 2,190 acres with approximately 329 of those acres at risk for increased sediment delivery. 427 acres of mechanical treatments would occur within RCA's. 3.8 miles of temporary roads would be constructed, with 0.59 miles of those being within RCA's. 283 acres of prescribed burning would be applied in RCA's. SMR's would be implemented to minimize the risk of increased sediment delivery and impacts to RCA's. Water quality for beneficial uses is expected to be maintained. The risk for increased sediment delivery is slightly higher under this alternative than under Alternative 3 because of the higher number of acres treated.		would occur across 706 acres with approximately 106 of those acres at risk for increased sediment delivery. 128 acres of mechanical treatments will occur within RCA's. No temporary roads would be constructed. 274 acres of prescribed burning would be applied in RCA's. SMR's would be implemented to minimize the risk of increased sediment delivery and impacts to RCA's. Water quality for beneficial uses is expected to be maintained. The risk for increased sediment delivery is slightly lower under this alternative than under Alternative 1 because fewer acres would be treated.

Chapter 3: Environmental Consequences

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of the alternatives.

Effects Relative to FONSI Significance Elements

In 1978, the Council on Environmental Quality promulgated regulations for implementing the National Environmental Policy Act (NEPA). These regulations (40 CFR Parts 1500 through 1508) include the definition of "significantly" as used in assessing a proposal's effects on the human environment under NEPA (40 CFR 1508.27). The ten elements of this definition are critical to reducing administrative burden and paperwork through use of a ***"finding of no significant impact***" (FONSI) when an action would not have significant effects on the human environment and would therefore be exempt from the requirement to prepare an environmental impact statement. Assessing the potential for significant effects under NEPA requires considerations of both the context and intensity of the effects of a proposed action.

The local context of the proposed action is limited to the northern portion of the Truckee Ranger District of the Tahoe National Forest within the approximately 9,000 acre Sagehen Basin; it is located roughly 10 miles north of Truckee, California, west of Highway 89 as depicted on the project maps (Appendix B). The Tahoe National Forest is comprised of about 800,000 acres of NFS lands. The acreage proposed for treatment under the Sagehen project represents less than one-half of one percent (2,621 acres in Alternative 1 and 1,132 acres in Alternative 3) of acreage of NFS lands on the Forest; the entire Sagehen Project Area represents approximately 1.2 percent (9,478 acres) of the Forest's total acreage. Thus in terms of the affected area, the proposed action would affect a very small portion of the Tahoe National Forest land base.

The primary project activities, such as forest thinning, prescribed fire, road maintenance, temporary road construction and decommissioning, are limited in intensity by project design features as well as the nature of the activities. Resource protections incorporated into the project design decrease risk of high intensity environmental effects as do avoidance and mitigation measures (SMRs, Appendix A). The implementation of project activities would be spread out over a five to ten-year time period. Project activities would be implemented seasonally during the spring, summer and fall as conditions allow.

Resource specialist reports were prepared in support of this EA for the following resource areas and disciplines: forest vegetation, fire and fuels, soils, hydrology, air quality, terrestrial wildlife species, aquatic wildlife species, plant and fungi species, cultural resources, road management, economics and health and safety. These reports are hereby incorporated by reference into this document and are part of the project record for this EA. The reports are on file with the Tahoe National Forest and are available upon request.

The above referenced reports indicate that the proposed action would not pose significant short- or long-term effects on the environment. The context of the proposed action is limited to minor, local,

short-term effects within the Sagehen Project Area. No significant effects, either long or short term, regional or societal, are anticipated. The following sections of Chapter 3 present the analysis of effects relative to the ten FONSI Elements.

Element 1. Impacts that may be both beneficial and adverse (40 CFR 1508.27 (b)(1)).

Forest Vegetation

The information presented in this section of the EA and in subsequent sections discussing forest vegetation is summarized from the Sagehen Silviculture Report (October, 2012), which is hereby incorporated by reference. The complete Silviculture Report is part of the Sagehen Project Record on file with the Tahoe National Forest and is available upon request.

Indicators Used To Analyze Impacts To Forest Stands

The following indicators are used to assess the impacts of the proposed action and other alternatives on forest stand conditions in the Sagehen Project Area: stand density, medium and large trees, tree mortality, canopy cover and variability. The sections below discuss each of these indicators in detail and explain why each was selected for this analysis.

Stand Density

A number of parameters are available to serve as metrics for stand density, among them basal area, volume, and stand density index. Basal area (defined by the area occupied by the cross-section of tree stems at a person's breast height (4.5 feet)) was selected for this analysis. Basal area has proven to be a useful metric for many forest elements. Generally, higher amounts of basal area equal more dense conditions, which can lead to decreased growth rates and an increase in density induced stresses. Ultimately, these stresses are exacerbated if the majority of the stand's basal area is in smaller trees. It is therefore important to understand which tree size classes comprise the majority of a stand's basal area. Basal area and the percent of basal area in trees greater than 19.9 inches dbh is used in this analysis to compare treatment effects on stand density.

Medium and Large Trees

As discussed in the GTR-220, "large" trees vary with forest type and site productivity, and there is no set size at which a tree takes on the positive ecosystem attributes of a larger living structure (North et al. 2009). For purposes of this analysis, the medium and large tree indicator is represented by trees greater than 19.9 inches dbh. Trees greater than 19.9 inches dbh are generally underrepresented in the Sagehen Project Area due to historic logging and stand replacing fires. Their presence ensures a unique, natural and historic seed source remains on the landscape while adding vertical and horizontal structure to an otherwise relatively younger forest. Trees of this size are generally more resilient to disturbance because of their relatively thicker bark and elevated crown base heights, which can mitigate fire effects and repel beetle attack. In general, a stand that developed under active fire conditions in the Sagehen Basin would have been expected to have the majority of its basal area in larger trees.

Tree Mortality

An important issue for forest management is how to assess and predict amounts of tree mortality associated with stand densities in different environments, and amounts of tree mortality that are either desirable or undesirable in terms of forest structure. The likelihood of disturbances becoming stand replacing increases in probability as stand density and the degree of homogeneous conditions increases. Yet, precipitous drops in tree populations as a result of stand replacing disturbances are hard to predict. Therefore, this report will focus on how density directly affects mortality while qualitatively discussing how size and intensity of treatments affect probabilities of stand replacing disturbances.

Canopy Cover

Canopy cover is an indicator that is significant, silviculturally, when analyzed as a signature of tree growth potential as well as the probability of shade intolerant versus tolerant tree species regeneration. However, since Sagehen Project goals are more focused on structure and resiliency over growth, its importance as a silvicultural indicator is lessened. Canopy cover, however, remains important in measuring the effect of treatments on other resources, such as fire behavior and wildlife habitat, and therefore will be utilized as an indicator in this report. Canopy cover is defined as the percentage of forest floor covered by the vertical projection of the tree crowns (Jennings et al. 1999 *in* North 2012).

Variability

It has long been understood that forests are highly variable at many scales, but only recently has science been able to assess levels of variability at various scales relative to important ecosystem processes. As the GTR 220 explains, "In the Sierra Nevada, historical data (Bouldin 1999, Lieberg 1902), narratives (Muir 1911), and reconstruction studies (Barbour et al. 2002, Bonnicksen and Stone 1982, Minnich et al. 1995, North et al. 2007, Taylor 2004) indicate mixed conifer forests were highly clustered with groups of trees separated by sparsely treed or open gap conditions. This clustering can be important for regenerating shade-intolerant pine (Gray et al. 2005, North et al. 2004, York and Battles 2008, York et al. 2003). Managed variability refers to the approach of designing silvicultural prescriptions to enhance heterogeneity at multiple spatial scales (site, stand, and landscape scales). The Sagehen Project silvicultural prescriptions (specifically dense cover areas, early seral openings, variable thinning, and legacy tree treatments) are applied at varying intensities, based on differences in slope position, slope aspect, and slope steepness, with the Project's emphasis areas providing the template for this variation. Carefully managing variability in this way is aimed at developing forest conditions expected under an active fire regime with active fire conditions.

Methodology And Assumptions

Several datasets are available to assess existing conditions in the Sagehen Project Area, including:

- stand examination data collected in the natural stands proposed for mechanical thinning treatments, using common stand exam protocol, during the summer of 2003;
- remotely sensed vegetation data;
- forest inventory data collected from more than 500 permanent vegetation plots by UC Berkeley researchers in 2006; and

- basal area plots measured within emphasis areas that were lacking representative information from the above datasets.

All four of these datasets were used to inform deliberations during collaborative development of the proposed action, particularly to establish objectives for post-treatment residual basal area within each unit's emphasis areas. This analysis relies primarily on the UC Berkeley forest inventory data to characterize existing conditions, past treatment and model 30-year projections for the silvicultural indicators.

Existing Conditions

Forest inventory data collected from more than 500 permanent vegetation plots by UC Berkeley researchers in 2006 provided the basis for quantifying existing conditions in the proposed treatment units. The Forest Vegetation Simulator (FVS) model (South Central Oregon Northern California variant) was used to "grow" the inventory data forward to represent conditions in 2011.

Post-Treatment Conditions

Several data sources were used to assess post-treatment stand conditions following application of the proposed silviculture and fuels prescriptions: (1) basal area plots measured during tree marking, (2) pre- and post-treatment data gathered in two 3-acre test plots, and (3) Forest Vegetation Simulator (FVS) modeling outputs.

Projected Conditions

The Forest Vegetation Simulator (FVS) (Dixon 2003) was used to model conditions at 30 years after application of the silviculture and fuels prescriptions proposed under each alternative. The FVS model's South Central Oregon Northern California variant was used for all simulations. Immediate post-treatment stand conditions (based on the post-treatment information described in the preceding section) were entered into FVS as a starting point for the simulations.

The modeled results from FVS are not intended to be absolute values, but rather they display relative trends in stand development for the emphasis areas within each treatment unit. It is important to note that, while the model is an abstraction of reality and does not provide an exact representation of on-the-ground conditions, it is a useful tool for making comparisons between the alternatives.

Direct and Indirect Effects

Stand density, medium and large tree, mortality, and canopy cover direct and indirect effects will be analyzed alternative by alternative, whereas variability will be analyzed by comparing metrics between alternatives.

Alternative 1. Effects of the Proposed Action

The following discussion examines the direct and indirect effects of treatments in the change from current condition to the immediate post treatment condition in some instances and 30 years post treatment in others. The subsequent indirect effects of the treatments can be traced through changes in average stand conditions over time as shown by stand density, medium and large trees, tree mortality, and canopy cover. Indirect effects of the proposed action are caused by the reduction in inter-tree competition that permits individual trees greater access to light, water and nutrients. Over time, this

results in an observable growth response for height and diameter, especially in smaller diameter classes that have been released from competition from nearby brush and trees. Since the treatment areas would have improved growing conditions, overall resistance to environmental stress, including insect attack, drought, or disease, would improve.

Stand Density

Alternative 1 would retain 69% of existing basal area compared to current basal area. This reduction in stand densities would reduce inter-tree competition as well as decrease probabilities of stand replacing disturbances. Further, as described under the variable thinning prescription and emphasis area discussion, ground and topographic conditions dictate where much of the remaining basal area resides. In other words, it is expected that Alternative 1's treatments would retain greater amounts of basal area in areas that would have supported higher stand densities under active fire conditions, while treatments would concentrate greater amounts of basal area reductions in areas that might not have been able to support as much basal area.

Post-treatment projections show a concentration of residual basal area in trees greater than 19.9 inches dbh, which would further enhance the resiliency of the remaining trees. Using a weighted average over the entire treatment units, there would be an increase of approximately 22 percent of the basal area in trees greater than 19.9 inches dbh 30 years post treatment compared with basal area immediately after treatment. This movement can be attributed to both the removal of many of the smaller trees, as described in the suppressed cut prescription, which immediately moves the majority of the remaining basal area into larger size classes, as well as the improved growth over a 30-year period which occurs as a result of the increased amount of available resources for the remaining trees to utilize. The combination of reducing basal area and increasing the amount of that basal area in trees greater than 19.9 inches dbh after 30 years reduces the total number of trees, most of which are smaller. Ultimately, this diminishes density related stresses on the remaining tree population, which will increase tree resiliency to disturbance which in turn reduces probabilities of that disturbance to become a stand replacing disturbance.

Medium and Large Trees

Under current conditions, the majority of the basal area is in trees smaller than 19.9 inches dbh, which creates a reverse-J diameter distribution (with large numbers of small trees and relatively few large-diameter trees). GTR-220 explains, "Research suggests that fire prone forests rarely had reverse-J diameter distributions" (North et al., 2009). The reduction of basal area combined with movement of the basal area to medium and large trees not only reduces density stresses within the treatment units, but also moves the units away from existing reverse-J diameter distributions (majority of the basal area in smaller trees). Approximately 49 percent of the basal area in medium and large trees is projected in 30 years across the project area's treatment units. However, treatment units with natural developed forest conditions would have approximately 71 percent of their basal area in medium and large trees 30 years post treatment, which is consistent with what research suggests as a diameter distribution for a fire-prone forest (North et al., 2009).

Although the majority of the basal area removed would be in trees less than 20 inches dbh, there are some instances that would warrant the removal of trees between 20 inches dbh and 29.9 inches dbh in order to meet project goals. Table 3.1 below shows the amount of trees per acre in different size classes marked for removal in the "mechanical thinning" units of the project. (The other units have tree cutting, but the maximum tree size that is proposed to be felled is 15.9 inches dbh).

Table 3.1: Alternative 1: Size Class Breakdown of Trees greater than 9.9 inches dbh Marked for Removal on Average per Acre (all mechanically thinned units – 2,105 acres)

Project Unit	Total Unit Acres	Average Trees per Acre Marked for Removal 10 – 19.9 inches dbh	Average Trees per Acre Marked for Removal 20 – 29.9 inches dbh	Average Trees per Acre Marked for Removal > 30 inches dbh
Unit 33 NDF*	118	26	0	0
Unit 34 NDF	68	26	0	0
Unit 35 NDF	64	24	0	0
Unit 36 NDF	101	31	1	0
Unit 38 NDF	210	13	13	0
Unit 46 P*	621	67	0	0
Unit 73 NDF	144	26	.2	0
Unit 85 NDF	64	11	0	0
Unit 87 P	207	68	0	0
Unit 89 NDF	34	36	0	0
Unit 90 NDF	40	47	0	0
Unit 156 NDF	84	27	0	0
Unit 163 NDF	82	25	0	0
Unit 213 NDF	268	15	6	0
Weighted Average		**40**	**2**	**0**

***In the table above, NDF is Natural Developed Forest; P is Plantation.**

In areas where there is an existing higher amount of basal area combined with higher percentages of the basal area in medium and large trees, proportionally higher amounts of medium and large trees are marked for removal in order to meet Sagehen Project goals, for example strategic basal area reductions for variability and wildlife habitat improvement. In other words, although the prescriptions require the largest trees to be left, if most of the existing trees are medium and large-sized, then some will be marked for removal. In units where most trees are less than 20 inches dbh, then the medium and large trees are retained.

Although size classes are generally displayed in 9.9-inch ranges, it may help the discussion to split out whether the majority of those trees are at the upper or lower end of that range considering the intent of the prescriptions is to leave the largest trees when given the choice. Table 3.2 shows how many trees are marked for removal in size class 20-22.9 inches dbh and how many trees are marked for removal in size class 23-29.9 inches dbh.

Table 3.2: 20-29.9 inch dbh Size Class Breakdown of Trees Marked for Removal per Acre in all mechanically thinned units – 2,105 acres

Size Class @ dbh	# of Trees Marked for Removal per Acre
20-22.9 inches	2
23-29.9 inches	.1
Totals	**2.1**

Of the trees marked for removal greater than 10 inches dbh, only about 5 percent of those trees were between 20 inches dbh and 22.9 inches dbh. Only 1.4 percent of **all** trees marked for removal were between 20 inches dbh and 22.9 inches dbh. While only about 0.3 percent of trees marked for removal greater than ten inches dbh, and only 0.1 percent of **all** trees marked for removal were between 23 inches dbh and 29.9 inches dbh (these percentages include medium and large trees marked for removal under the early seral opening prescription). These figures mirror the intent of the prescriptions by focusing the majority of the removal on trees under 20 inches dbh and those trees that were to be selected for removal between 20.9 inches dbh and 29.9 inches dbh would be relatively rare and would be mostly comprised of the lower end of that size class.

On average across all of the Project Area's treatment units, there are approximately 17 trees per acre over 19.9 inches dbh. If units that are in an early seral stage (plantations and natural young forests) are removed from consideration, approximately 28 medium and large trees per acre exist in the remaining treatment units (occupied by natural developed forest stands).

FVS projects that approximately 16 medium and large trees per acre will remain across all units, post treatment (not including DCAs and ESOs). However, this average includes areas that have been affected by stand replacing fire and are now in a young forest condition (although there are a small number of residual medium and large trees present in some of these stands). In order to effectively assess the remaining medium and large tree population under implementation of Alternative 1, compared to what might have existed in later seral stands that had developed with active fire, the analysis further considers natural developed forest stands' medium and large tree populations. FVS predicts approximately 25 medium and large trees per acre would remain on average in the treatment units with natural developed forest conditions post treatment (minus DCAs and ESOs) under Alternative 1.

Tree Mortality

Hence, the projected overall mortality rate would allow trees within the stands treated under Alternative 1 to reach ages that often have old growth characteristics. It is known, however, that mortality rates are rarely constant and difficult to forecast where mortality might occur. Therefore, this scenario is designed to simply illustrate what the mortality rate may mean for a stand of trees over time. Further, with the majority of the basal area in medium and large trees combined with the decadent feature enhancement prescription, Alternative 1 mortalities would most likely closely resemble what might have occurred under active fire conditions.

Canopy Cover

Alternative 1 prescriptions reduce canopy cover by approximately 15%. Although different units may have unique canopy cover requirements, set forth by the Forest Plan, all units would remain within Forest Plan standards and guidelines for canopy cover retention. For example, units that overlap a California Spotted Owl Home Range Core Area, such as unit 213, would maintain at least 50 percent canopy cover, consistent with Forest Plan standards and guidelines. Unit 213 treatments were therefore prescribed to retain 55 percent canopy cover. Not only do Alternative 1 prescriptions meet Forest Plan requirements, but canopy cover reduction between trees and groups of trees is expected to free up some available growing space for the remaining trees as well provide opportunities for reproducing more shade intolerant tree species. Further, as described under the variable thinning prescription and emphasis area discussion, ground and topographic conditions dictate where much of the canopy cover reductions would occur. In other words, treatments under Alternative 1 are designed to reduce relatively more canopy cover in areas that would have supported higher amounts of shade intolerant regeneration, but a lower overall tree population under active fire conditions. In areas that would have had a higher composition of shade tolerant species and a larger overall tree population with active fire, Alternative 1 treatments retain higher amounts of canopy cover.

SUMMARY OF DIRECT AND INDIRECT EFFECTS of the Proposed Action (Alternative 1)

The implementation of the proposed action within the Sagehen Project Area would not only meet project goals, but would also improve forest stand conditions immediately after treatment and well into the future. Competition, as revealed in the stand density and canopy cover discussions, would remain at levels that would enhance tree and overall stand resiliency for the next 30 years. Those levels, as shown through mortality calculations however, would not be reduced at the expense of the recruitment of larger dead structures. In fact, the proposed action shows much of the projected mortality occurring in

trees greater than 14.9 inches dbh. Although present conditions may be currently producing a reasonable amount of mortality, most of that occurs in trees that are much smaller and may have limited value for long term forest structure. Further, this report discloses the size and amounts of trees that the proposed action would remove. Although there are some instances where trees between 20 inches dbh and 29.9 inches dbh would be slated for removal to meet some project goals, the vast majority of trees to be removed would be in the smaller size classes. This ensures a healthy population of medium and large, resilient trees across much of the Project Area while freeing up available resources for smaller trees to guarantee a replacement population of medium and large trees.

Alternative 2. Effects of the "No Action" Alternative:

The following discussion examines the direct and indirect effects of taking no action in the Sagehen Project's treatment units after 30 years. The subsequent indirect effects of no action can be traced through changes in average stand conditions over time as shown by stand density, numbers of medium and large trees, tree mortality, and canopy cover. Indirect effects of the No Action Alternative are caused by an increase in inter-tree competition that limits the ability of individual trees to access to light, water, and nutrients. Over time, this results in a reduction in stand resiliency, a continued trend of the majority of the basal area occurring in smaller trees, increased mortality, and reduced levels of mortality in trees greater than 14.9 inches dbh compared to the action alternatives (Alternatives 1 and 3).

Stand Density

On weighted average for Alternative 2, the basal area would increase by about 63 square feet per acre over the Project Area. FVS modeling shows many units beginning to exceed a basal area of 300 square feet per acre after 30 years. Although portions of stands may be able to support pockets of this level of density, basal areas exceeding 300 square feet per acre across a stand of trees is most likely not consistent with basal area levels that would have developed under active fire conditions, and these consistently higher levels of basal area would be expected to put the entire stand at a greater risk of a stand replacing disturbance.

After 30 years, the No Action Alternative would leave the majority of the basal area in the Sagehen Project Area treatment units in trees less than 20 inches dbh. High basal areas in many units, combined with a larger portion of that basal area residing in smaller trees, would create a high stress environment where many trees would be competing for a limited amount of resources.

Medium and Large Trees

The majority of the Project Area's treatment unit basal areas would remain in trees less than 20 inches dbh. The reverse-J diameter distribution (stands comprised of large numbers of small trees and relatively few large-diameter trees) would generally remain intact across the treatment units, and is inconsistent with the diameter distribution that would have developed under active fire conditions.

No larger living trees would be removed under the No Action Alternative. This would ensure that the larger living trees remained on the landscape in the short term; however, as the basal area and mortality discussions for the No Action Alternative explain, it may not ensure their numbers remain on the

landscape in the long term. Further, in contrast to Alternative 1, implementation of the No Action Alternative would not allow forest managers to create favorable growing conditions for the larger living trees that would have the best opportunity to survive, nor would managers be able to favor tree species that would be the dominant larger tree replacements.

Tree Mortality

The predicted annual mortality rate in 30 years after no treatments were implemented in the Sagehen Project area is about 0.80 percent (weighted average) across the project. Using the example from above, a 200-acre stand with 300 trees per acre would lose as many as 480 trees annually to resource stress alone, which is well over two trees per acre per year. Trees would have trouble reaching ages above 130 years and would most likely not acquire old growth characteristics. Further, because many trees are dying at young ages, larger dead structures (snags) would be a smaller percentage of the mortality. As previously stated, mortality rates are rarely constant and difficult to forecast where mortality might occur. This scenario merely illustrates a potential outcome over time for a stand of trees under Alternative 2.

After 30 years of no action, the weighted average annual percent of trees greater than 14.9 inches dbh expected to die only increases to 26 percent in 30 years. This means that in 30 years, only a quarter of all the trees drying will be in trees over 14.9 inches dbh. Therefore although mortality rates continue to increase over time, that mortality, is not concentrated in trees greater than 14.9 inches dbh. Although a certain amount of smaller dead material is desirable for nutrient cycling and other project goals, this amount exceeds levels that would have developed with active fire conditions under an active fire regime. A healthy Sierra Nevada forest is believed to require a robust medium and large tree cycle that depends on a vigorous replacement population, a resilient current population, and sustainable amounts of mortality from larger trees that perish due to old age and not resource stress. The No Action Alternative, as shown in this discussion, moderates this medium and large tree cycle.

Canopy Cover

Canopy cover would be unaltered under the No Action Alternative and would be expected to increase over time. Although this increase over time would benefit some project goals, it would minimize the ability for shade intolerant species to regenerate across the stand. Shade tolerant species would continue to establish, but the stands would have few unencumbered early and mid seral shade intolerant trees and therefore the future replacement of the stands larger (greater than 19.9 inches dbh) shade intolerant population would most likely be by larger shade tolerant trees. These shade tolerant trees are somewhat less resilient to disturbance, and although have value in certain numbers, the species overabundance would exacerbate many forest disturbances and decrease the overall stand resiliency.

SUMMARY OF DIRECT AND INDIRECT EFFECTS of the No Action Alternative (Alternative 2)

The direct and indirect effects of the No Action Alternative would maintain and perpetuate homogenous conditions, which would leave the Project Area susceptible to uncharacteristically large scale disturbances in what has historically been a heterogeneous forest affected by smaller and varied

disturbances. Competition would increase among all trees and stress induced mortality would be unpredictable and occur in undesirable size classes. The shift in shade tolerant tree species would continue as increasing canopy cover limited the ability for shade intolerant species to regenerate.

Alternative 3. Effects of the "Non-commercial Funding" Alternative:

The following sections discuss the direct and indirect effects of treatments in the change from current condition to the immediate post treatment condition in some instances and 30 years post treatment in others. The subsequent indirect effects of the treatments can be traced through changes in average stand conditions over time as shown by stand density, numbers of medium and large trees, tree mortality, and canopy cover. Indirect effects of the "Non Commercial Funding" Alternative are caused by the reduction in inter-tree competition that would permit individual trees greater access to light, water, and nutrients in the treated units. Although the sole focus of this alternative is hazardous fuels reduction, over time it would result in an observable growth response for height and diameter, especially in smaller diameter classes that have been released from competition from nearby brush and trees in the small number of units that were treated. Since the areas that were treated would have improved growing conditions, overall resistance to environmental stress, including insect attack, drought, or disease, would likely improve. However, given the limited extent of treatments under Alternative 3, the majority of the stands in the Sagehen Project Area would remain in a trajectory that is inconsistent with a fire regime one landscape with active fire conditions, making the area at higher risk to large scale disturbance and high mortalities from inter-tree competition in the future (30 years).

Stand Density

Alternative 3 would have minimal effects on reducing stand density (weighted average of approximately 10 square feet per acre basal area reduction) because the majority of units would not be treated under this alternative. Many units would begin to exceed a basal area of 300 square feet per acre after 30 years. Although portions of stands might be able to support pockets of this level of stand density, a basal area of greater than 300 square feet per acre across a stand of trees is most likely not consistent with stand densities that would have developed under active fire conditions and would likely put the entire stand at a greater risk of a stand replacing disturbance.

After 30 years, units that would receive treatment under Alternative 3 show slight to moderate increases in basal area in medium to large trees than units with no treatment. This increases the overall project weighted average percentage of basal area in trees greater than 19.9 inches dbh over the No Action Alternative, but leaves units that would not be treated with continued substantial amounts of their basal area in smaller trees, even after 30 years. This would most likely produce unsustainable amounts of mortality in those units.

Medium and Large Trees

Under Alternative 3, the majority of the Project Area's unit basal areas would remain in trees less than 20 inches dbh. The reverse-J diameter distribution (stands comprised of large numbers of small trees and relatively few large-diameter trees) would generally remain intact and is inconsistent with diameter distributions that would have developed under active fire conditions.

Generally, trees less than 12 inches dbh (with occasional trees between 12 and 18 inches dbh in the plantations) would be removed under the "Non Commercial Funding" Alternative. This would ensure that the larger living trees remain on the landscape in the short term, but might not ensure their numbers remain on the landscape in the long term. Further, in contrast to Alternative 1, implementation of Alternative 3 would not allow forest managers to create favorable growing conditions for the larger living trees that would have the best opportunity to survive, nor would managers be able to favor tree species that would be the dominant larger tree replacements.

Tree Mortality

The mortality weighted average across the Sagehen Project Area treatment units would be approximately 0.50 percent 30 years after the "Non Commercial Funding" Alternative's treatments (averaging units 46, 47, 61, 76, 91, 98, 99, 100, 282). While lower than the annual mortality rates under the No Action Alternative, this number is still quite high; however, even more concerning is the mortality percentage in many of the stands that would not be treated under this alternative. Of all the trees in the Project Area that are projected to die in the 30th year after Alternative 3 treatments are completed, only 36 percent of those trees are larger than 14.9 inches. Therefore mortality rates not only increase over time, but that mortality is mostly concentrated in trees less than 15 inches dbh. This trend is still not consistent with conditions associated with a forest ecosystem that experienced active fire under an active fire regime.

Canopy Cover

Canopy cover would be reduced in units receiving treatment under the "Non Commercial Funding" Alternative, but would stay well within Forest Plan requirements. This canopy cover reduction between trees and groups of trees is expected to free up some available growing space for the remaining trees as well provide opportunities for more shade intolerant reproduction. However, Alternative 3 prescriptions do not necessarily take site conditions or topography into account. Therefore, residual stand conditions under Alternative 3 would not be expected to closely reflect conditions that might have existed under more active fire conditions.

Canopy cover would be unaltered in units receiving no treatment. In these areas, canopy cover would continue to increase. Although this increase over time would benefit some project goals, it would minimize the ability for shade intolerant species to regenerate across the stand. Shade tolerant species would continue to establish, but the stand would be void of unencumbered early and mid seral shade intolerant trees and therefore the future replacement of the stands' larger (greater than 19.9 inches dbh) shade intolerant population would most likely be by larger shade tolerant trees. These shade tolerant trees are somewhat less resilient to disturbance, and although they have value in certain numbers, the species overabundance would exacerbate many forest disturbances and decrease overall stand resiliency.

SUMMARY OF DIRECT AND INDIRECT EFFECTS of the "Non Commercial Funding" Alternative (Alternative 3)

The direct and indirect effects of the "Non Commercial Funding" Alternative would maintain and perpetuate homogenous conditions in units that would not be receiving treatment, which would leave the overall Project Area susceptible to uncharacteristically large scale disturbances in what has historically been a heterogeneous forest affected by small and varied disturbances. These untreated areas would see competition increase among all trees and stress induced mortality would be unpredictable and would occur in undesirable size classes. The shift in shade tolerant tree species would continue as increasing canopy cover would limit the ability for shade intolerant species to regenerate. Although some units would receive treatment, which may alleviate some of the indirect effects seen in units without treatment, benefits would primarily be realized within unit boundaries. Because these treatments would be relatively modest in effects and limited in size compared to the proposed action (Alternative 1), the larger effect on the surrounding landscape would be marginal under implementation of Alternative 3.

Effects of the Alternatives on Variability:

Variability is assessed at three scales: site, stand, and landscape. The metric for variability at the site scale is the coefficient of variation for pre- and post-treatment basal area and canopy cover. Percentage of treated area in early seral openings (ESOs) and dense cover areas (DCAs) is used as the metric for assessing variability at the stand scale. The metrics used for analyzing managed variability at the landscape scale are basal area, canopy cover, and mortality. The application of a combination of all or some of the silviculture and fuels prescriptions is, by design, intended to strategically introduce measurable variability at different scales in the Sagehen Project Area, which currently lacks a certain amount of variability that might have existed under active fire conditions. There is no baseline for variability; hence, relative differences in variability between the alternatives are assessed in this analysis.

Site Scale Variability

For this analysis, the post-treatment test plots are assumed to represent variability effects under Alternative 1, and pre-treatment test plots are assumed to represent variability effects under Alternative 2 (No Action). Coefficient of variation (CV) is a useful relative metric to compare variability changes across alternatives at the site scale. The CV was calculated for basal area and canopy cover between several sample plots that were measured both pre and post-treatment within the two project test plots. The CV data shows that Alternative 1 would result in an 18 percent higher basal area CV and a 9 percent higher canopy cover CV compared with Alternative 2; thus, variability for basal area and canopy cover would be greater under Alternative 1 than Alternative 2.

Although test plots representing Alternative 3 prescriptions were not used in this analysis, applying Alternative 3 prescriptions would most likely produce less variable conditions at the site scale than both Alternative 1 and Alternative 2. The sole purpose of Alternative 3 prescriptions is to reduce fuels. Although this would not eliminate variability at the site scale, leaving only the largest, well-spaced trees would maintain more consistent crown cover percentages as well as constant basal areas. Therefore, Alternative 3 would most likely have the least amount of variability of all the alternatives at the site scale, and Alternative 1 would have the most.

It is also important to analyze how variability is managed. This concept is best applied to Alternative 1. The silvicultural prescriptions for Alternative 1 are applied at varying intensities based on specific site conditions in the emphasis areas and provide the template for variability. The variable thinning prescription is proposed across more of the treatment units than any other treatment. This prescription enhances variability through implementation guidelines that retain groups of larger trees, create small and variably shaped gaps between clumps of larger trees and vary in small ways the manner in which the prescription is applied across sites to increase variability at the micro-site scale. Alternative 2 maintains some variability at the site scale, but the variability is random and may not be representative of what would occur under active fire conditions. Alternative 3 prescriptions, as discussed above, are not intended to increase variability and therefore any variability that occurred would most likely be by coincidence and might not occur in areas that would naturally have higher variability.

Stand Scale Variability

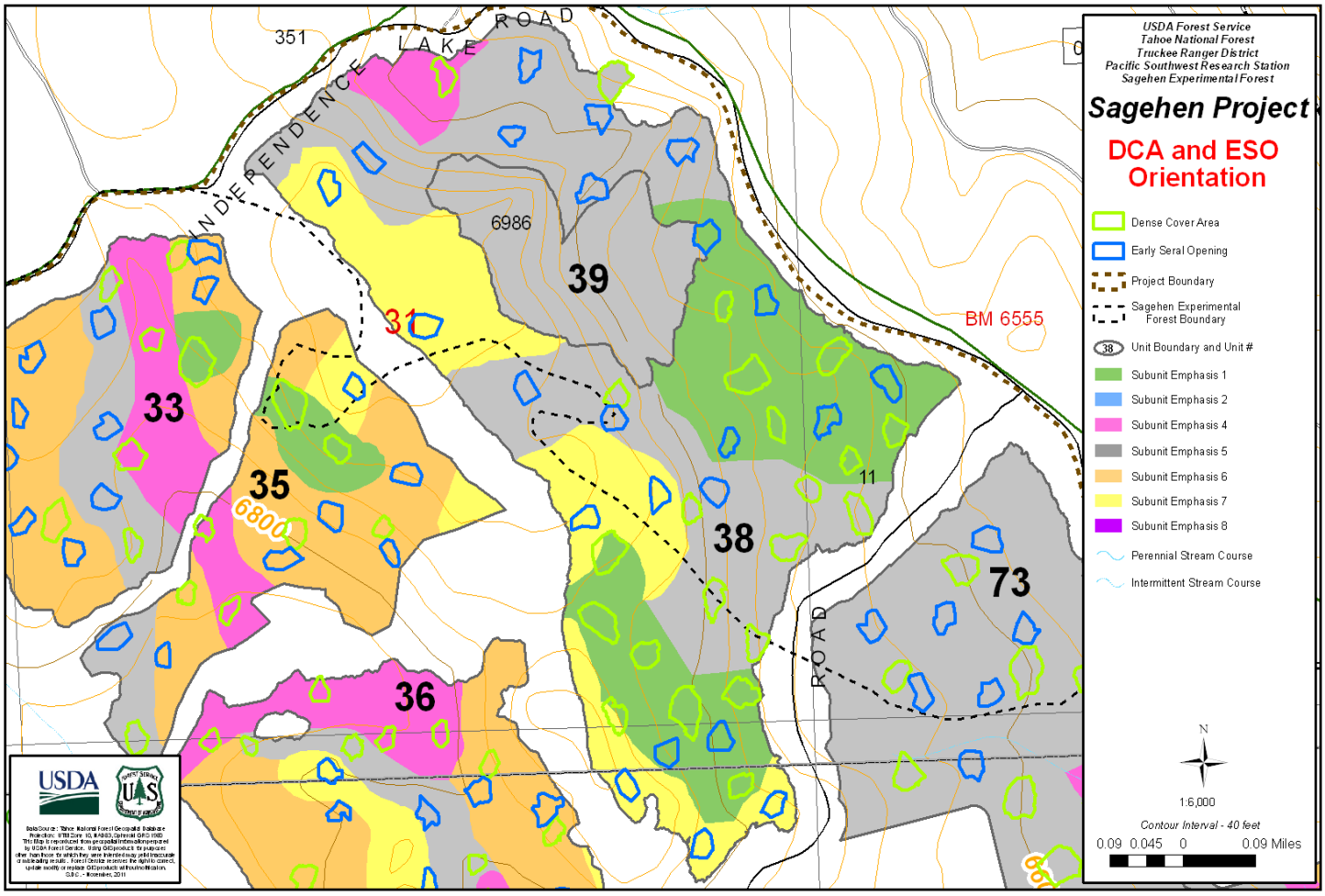
Under Alternative 1, increased stand variability, among other Project goals, would be achieved through the creation of early seral openings (ESOs) and dense cover areas (DCAs). The ESOs would create small, temporary situations of basal area and canopy cover metrics near zero while the DCAs would maintain much higher canopy cover percentages and basal areas that other prescriptions would not preserve. Under Alternative 1, approximately 6 percent of the total area within units would be treated with the DCA or ESO prescription.

Much of the Project Area in its current condition has become relatively homogeneous and has few within-stand openings or ESO-like areas such as would have developed under active fire conditions. Without dense areas (e.g. DCAs) intermixed with less dense and open areas (e.g. ESOs), there would be minimal variability at the stand scale under Alternative 2. In the event of potential future disturbances, the area's current homogeneous condition would likely lead to stand replacing events. Stand replacing events do create variability, but at a much larger scale than what would have developed with active fire conditions under an active fire regime.

Alternative 3 prescriptions are not intended to enhance variability. In fact, any natural variability at the stand scale would most likely be moderated by the Alternative 3 prescriptions.

As with variability at the site scale, it is important to understand how variability at the stand scale is managed under each alternative. The variability effect of the treated 6 percent in DCAs and ESOs across the Project Area under Alternative 1 is maximized through tactical spatial arrangement. A snapshot of this arrangement over the northeast portion of the Project Area can be seen in Figure 3.1

Figure 3.1: Alternative 1: A Sample DCA and ESO Orientation Snapshot



Notice the higher amounts of DCAs that occur in lower numbered emphasis areas and a higher amount of ESOs in higher numbered emphasis areas, mimicking what active fire might produce in these different topographical areas. Therefore, by applying these treatments strategically throughout the majority of the Project Area, variability is managed much more than if they were placed randomly. Alternative 2 would result in minimal variability, and since that minimal variability would not be managed, it would be largely random. Alternative 3 has only fuel reduction focused prescriptions, and any variability that was not moderated by the treatment prescriptions would be random and would not necessarily enhance variability.

Landscape Scale Variability

This can be measured within the landscape by correlating emphasis areas of the project area using canopy cover, basal area and mortality. Then, these indicators can be compared between alternatives. Analysis of the indicators shows that Alternative 1 has the highest amount of variability among all the alternatives when looking at canopy cover, and it does so with the least volatility (differences in weighted average canopy cover percentages between adjacent emphasis areas). Alternative 1 has a 31 percent decrease in volatility over Alternative 2 and a 65 percent decrease in volatility over Alternative 3.

Basal area can be analyzed between emphasis areas at the same point in time in order to assess managed variability at the landscape scale.

As with canopy cover, Alternative 1 shows the most variability in basal area between emphasis areas. Alternative 1 has the most variability as well as the least amount of volatility (differences in weighted average basal area between adjacent emphasis areas) of all alternatives. As measured using basal area, Alternative 1 is 65 percent less volatile than Alternative 2 and 132 percent less volatile than Alternative 3.

Finally, it is important to look at how mortality varies at the landscape scale. Because mortality expresses the culminating effects of each silvicultural prescription, such as basal area reduction targets and species preferences, it is important to understand how mortality responds with respect to variability between emphasis areas across all alternatives over time. Although mortality variability between emphasis areas of Alternative 1 decreases after treatment due to the initial moderation of density related stresses within all the emphasis areas from those treatments, the unique prescriptions within each emphasis area are projected to begin to take on mortality at different amounts by 2017. The CV for mortality is predicted to increase by as much as 35 percent in 25 years and is projected to be 4 percent higher than the current condition by 2041. Alternative 2 shows an initial "pop" in mortality variation, but over time, that begins to moderate and continues on a downward trend of homogenizing mortality through the analysis period. In 30 years, that mortality variation between emphasis areas is almost 20 percent less than Alternative 1. Alternative 3 fluctuates over time, but if analyzed as a trend, variability decreases over time and ultimately has similar amounts of variability as Alternative 2 in 2041, which is well below where Alternative 1 is projected to be at that same time.

This variability must also be understood in terms of volatility. Instead of trying to ascertain how volatile mortality is between emphasis areas over time, this analysis considers the volatility of that variability 30 years after treatment. Alternative 1 reduces mortality volatility between emphasis areas by as much as 4 percent over where Alternative 2 is predicted to be at the same time and over 160 percent reduction in volatility over where Alternative 3 is predicted to be at the same time.

Ultimately, variability can occur at many scales and be completely random, but it is understood that Sierra Nevada forest systems with more active fire conditions under an active fire regime showed variability at all scales (site, stand, and landscape) and were logically adapted to topographical situations. Alternative 1 shows enhanced variability over both Alternatives 2 and 3 in every indicator at every scale analyzed. Not only does Alternative 1 increase variability in every indicator at every scale analyzed, but does so strategically in a way that mimics what would have occurred with active fire conditions under an active fire regime.

Fire and Fuels

The following section summarizes information concerning fire and fuels environmental effects as analyzed in the Sagehen Project Fire and Fuels Report (February, 2013); the fire and fuels report is hereby incorporated by reference as part of this EA and is part of the Sagehen Project Record available from the Tahoe National Forest.

Indicators

The following section discusses the indicators used to assess the environmental consequences of the proposed action on fire and fuels. Indicators that will be evaluated are fire type (surface fire, active crown fire, passive crown fire), rate of spread and flame length. The indicators are briefly described below.

- **Fire Type** -There are three types of fire that are indicators for modeling. They are surface fire, passive crown fire and active crown fire.

    - ***Surface Fire*** –"Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation" (National Wildfire Coordinating Group, NWCG glossary of terms). Surface fire is important to measure because much of the Sagehen Basin historically burned as a surface fire with lower amounts of tree mortality than higher intensity fires. Surface fire is the desired condition for much of the Sagehen Basin.
    - ***Active Crown Fire*** –"A fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other. An active crown fire will kill most of the vegetation in its path.
    - ***Passive Crown Fire*** – "A fire in the crowns of trees in which trees or groups of trees torch, ignited by the passing front of the fire (National Wildfire Coordinating Group, NWCG glossary of terms). Some passive crown fire probably occurred in the Sagehen Basin historically.

- **Rate of Spread (ROS)** – "The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area" (National Wildfire Coordinating Group, NWCG glossary of terms).
- **Flame Length** –"Flame length is measured by the distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), and is an indicator of fire intensity" (National Wildfire Coordinating Group, NWCG glossary of terms). When Flame Lengths are less than four feet, fire can generally be attacked at the head or flanks by firefighters using hand tools. Flame lengths greater than four feet typically require mechanized and aerial fire suppression resources.

Methodology

The following modeling tools and data were used in the environmental analysis; they help predict fire and fuels effects for the project alternatives.

FlamMap is a fire behavior mapping and analysis program that computes potential fire behavior characteristics (rate of spread, flame length, fire type and fireline intensity) over an entire FARSITE landscape.
Farsite is a fire behavior and growth simulator. It is widely used by Fire Behavior Analysts from the USDA FS, USDI NPS, USDI BLM, and USDI BIA. Farsite predicts where a fire would move and how it would grow within a bracket of time, assuming no fire suppression activities.

Data used in modeling
FlamMap and Farsite both require input data which include fuel type, topography and weather. Different fuel types help determine how a fire reacts to the amount of live and dead material in the model where weather informs the model on what climatic conditions the fire will be burning in. Topography affects rate and direction of spread as well as flame length. The LANDFIRE Reference Database version 1.1.0, completed in 2011, was used to build the landscape data used in modeling fuels and topography for Sagehen Project. Fire modeling weather conditions assumed 90th percentile or average worst weather conditions as required by the Forest Plan. This means only 10% of observed weather days have had more severe fire weather than the conditions used for modeling purposes. Historical weather data (1991-2011) was obtained from the Stampede Remote Area Weather Station (RAWS), the most representative weather station for the project area.

Alternative 1 (Proposed Action)

Direct and Indirect Effects
As described in Chapter 2, Unit 39 is no longer proposed for treatment under Alternative 1. Although the elimination of treatment in unit 39 would yield different fire behavior modeling results, the interdisciplinary team fuels specialist and vegetation management specialist determined through careful deduction that different results, even if those results yielded higher fire intensities, would occur on such a small area (32 acres), which would still be surrounded by treated areas in Unit 38, that the conclusions summarized below and described in detail in the Sagehen Project Fire and Fuels Report for Alternative 1 would remain unchanged.

If Alternative 1 prescriptions were implemented, condition classes within the Sagehen Basin would change greatly from where those classes currently stand. Under this alternative, most of the treated project area (2,536 acres) would burn at relatively low intensity with flame lengths less than four feet at 90th percentile weather conditions. The fire type within most of the treatment areas would behave as a surface fire while small isolated patches within DCA's and untreated areas would be subject to passive and active crown fire behavior. High intensity fire would not be totally eliminated from the landscape, but would be limited to small patches across the treatment units; project modeling estimated 109 acres with passive or active crown fires, 101 acres with flame lengths greater than four feet and 193 acres with a rate of spread greater than 6.7 feet/minute. Potential wildfires within the treated areas are projected to be slow moving fires and would not be stand replacing crown fires but rather would behave as surface fires.

As discussed, implementing Alternative 1 prescriptions would decrease ROS, flame length and the opportunity for crown fires to occur. Consequently, large scale wildland fire behavior would be modified. Carrying out this alternative would also create heterogeneous forest stand conditions that would be expected to develop with active fire conditions under an active fire regime. Wildland fire behavior would be reduced and costs of wildfire suppression and emergency rehabilitation could be lessened with the avoidance of stand replacing fire. Therefore, Alternative 1 would meet fire and fuels goals and objectives.

Areas where fuels have been treated burn at lower intensities compared to untreated areas, reducing damage to the treated stands from wildfire. Alternative 1 prescriptions would decrease ROS, flame length and the opportunity for crown fires to occur. Wildfires enter the untreated stands at lower intensities, reducing damage to these areas. Fires burning at lower intensities would allow firefighters to have the upper hand on fire suppression and they would most likely be able to contain a low intensity fire quickly. If an untreated stand is producing 80 foot flame lengths, 80 feet plus the radiant heat will affect the edge of treated stands. "Treatments with substantial edge adjacent to untreated units are likely to suffer high numbers of dead trees along the boundary owing to radiant heat, even if fire behavior is reduced" (The Cone Fire: A Chance Reckoning for Fuel Treatments; Fire Science Brief, Issue 4, January 2008 www.firescience.gov).

Alternative 2—No Action

Direct and Indirect Effects

If no action occurred within the Sagehen Basin, condition classes in the area would show a continued deviation from historical fire regimes. Without disturbance, surface and ladder fuels would continue to build, increasing the future probability of larger scale fires, burning at higher intensities. Under this alternative, most of the treatment unit areas (2,169 acres) could sustain a passive and/or active crown fire with 90th percentile weather conditions. Furthermore, the risk of increased ROS, flame length, and crown fires would continue in the future. The probability of larger landscape scale wildland fire behavior would continue to rise. Costs of wildfire suppression and emergency rehabilitation would remain high if a stand replacing fire did affect the Project Area under 90th percentile weather in its current condition. Fire and fuels goals would not be met if the buildup of heavy fuel loading continues to contribute to high wildfire intensities.

Under the no action alternative, forest stands in the Sagehen Basin would be susceptible to disturbances such as fire, insect, and disease outbreaks over time as fuel loadings continued to increase due to conifer mortality and increasing stand densities. Fire control tactics would most likely be very costly and less effective if the disturbance processes such as fire or insect and disease outbreaks occurred in the Project Area's current condition. Therefore, fire and fuels goals would not be met if large scale wildland fire behavior continues to be a threat**.** Fuel loading within the untreated stands would continue to accumulate at a higher rate than treated stands.

Alternative 3—Non Commercial Funding Alternative

Direct and Indirect Effects

Alternative 3 would reduce fire behavior in treated areas but fire behavior would remain high in untreated areas. Alternative 3 protects the area around the Sagehen Field Station but the rest of the Basin would still have a higher flame length and ROS as well as more crown fire compared to Alternative 1. Flame lengths and ROS are reduced in treated areas; however untreated areas would continue to have high fire intensity and ROS under 90th percentile conditions. Insufficient acreage would be treated under this alternative to modify landscape scale wildland fire behavior. This alternative would not create heterogeneous forest stand conditions that would be expected to develop with active fire conditions under an active fire regime.

Condition classes in treated areas would be reduced thus bringing stands more in line with the historical fire regime. Without disturbance, surface and ladder fuels would continue to build, increasing an already high probability of larger scale fires, burning at higher intensities in untreated areas. Costs of wildfire suppression and emergency rehabilitation would remain high if a stand replacing fire did affect the Project Area under 90th percentile weather in untreated areas. Alternative 3 would decrease the susceptibility of treated stands to disturbances such as fire, insect, and disease outbreaks; however, this alternative only treats a small portion of the Sagehen Basin. Fire and fuels goals would not be met as the buildup of heavy fuel loading in untreated areas would continue under this alternative.

Areas where fuels have been treated burn at lower intensities compared to untreated areas, reducing damage to the treated stands from wildfire. ROS, flame lengths and fire type is decreased in treated areas following implementation. Adjacent untreated stands to treatment areas would benefit from this alternative. However only a portion of the Sagehen Basin is treated, therefore only a portion on untreated areas would benefit. Firefighters might be able to suppress a fire if it started in a treated area. Fuel loading within the untreated stands would continue to accumulate at a higher rate than treated stands. The accumulation of fuels in untreated stands would not only affect those stands but could affect treated stands as well. If an untreated stand is producing 80 foot flame lengths, the radiant heat will affect the edge of treated stands. “Treatments with substantial edge adjacent to untreated units are likely to suffer high numbers of dead trees along the boundary owing to radiant heat, even if fire behavior is reduced” (The Cone Fire: A Chance Reckoning for Fuel Treatments; Fire Science Brief, Issue 4, January 2008 www.firescience.gov).

FARSITE Modeling Scenarios for the Alternatives

For the Farsite runs performed for Sagehen, ignition points were selected by individuals on the Truckee Ranger District familiar with potential ignition sources, local weather and current vegetative conditions. Outputs of fire perimeter growth or ROS in time and space provide visual estimations of the influence of fuel treatments and other landscape elements on fire growth. Farsite modeling is done as if no fire suppression would occur. This is somewhat unrealistic because fire suppression would occur if a fire

were to start in or near the area. However, it is the best way to model and compare scenarios and fire behavior due to the complexities and dynamics of the human element with fire suppression.

FARSITE Scenario 1

Table 3.3 below compares each alternative with a fire starting at Sagehen Campground and a wind coming out of the north under 90th percentile weather conditions. Alternative 1 would be the best option for keeping the fire to the least amount of acres. However, the north wind simulation with ignition at Sagehen Campground still allows a fire to grow to over 1,000 acres under all alternatives. This is due to an untreated area located south of the Sagehen Campground. Once a fire hits an untreated area, control efforts become more difficult and a fire can advance quickly. Under all alternatives this north wind simulation with the ignition point at Sagehen Campground allows for a larger fire growth in a short amount of time.

Table 3.3: Acres burned with ignition at Sagehen Campground with a north wind under 90th percentile weather conditions

Alternative	Acres burned after 48 hours	Acres burned after 72 hours
Alternative 1	1,012	1,865
Alternative 2	1,435	4,217
Alternative 3	1,255	2,507

FARSITE Scenario 2

Table 3.4 below compares each alternative with a fire starting at the Sagehen Field Station and a wind coming out of the south-southwest under 90th percentile weather conditions. Alternative 1 and Alternative 3 substantially reduce landscape scale fire growth over Alternative 2. Alternative 1 and Alternative 3 have very similar outputs due to placement of treatment units and their alignment with the ignition point, and wind direction. As mentioned earlier, this is only a three day simulation. One can imagine fire growth for Alternative 2 if more days were modeled. It is understood that when fires grow to this size in a short amount of time, ROS is higher, flame lengths are higher and more extreme fire behavior can be expected.

Table 3.4: Acres burned with ignition at Sagehen Field Station with a south-southwest wind under 90th percentile weather conditions

Alternative	Acres burned after 48 hours	Acres burned after 72 hours
Alternative 1	7	261

Alternative 2	1,713	6,455
Alternative 3	7	385

FARSITE Scenario 3

Table 3.5 below compares each alternative with an ignition point south of Sagehen Basin with a wind coming out of the south under 90th percentile weather conditions. Alternative 1 and Alternative 3 keep a wildfire at fewer acres than Alternative 2. However both Alternative 1 and 3 still allow a fire to grow to over 1,400 acres within 48 hours. As mentioned earlier, this is only a three day simulation. One can imagine fire growth for Alternative 2 if more days were modeled. It is understood that when fires get to a larger size they become more difficult to control.

Table 3.5: Acres burned with ignition south of the Sagehen Field Station with a south wind under 90th percentile weather conditions

Alternative	Acres burned after 48 hours	Acres burned after 72 hours
Alternative 1	1,404	3,145
Alternative 2	2,139	6,224
Alternative 3	1,404	3,145

Soil Productivity

The following analysis is based on the Sagehen project soils report (January, 2013) hereby incorporated by reference and available upon request from the Tahoe National Forest. The National Forest Management Act (NFMA 1976) requires that forest management practices do not permanently impair the productivity of the land. Direction is outlined in the Region 5 Soil Management Handbook Supplement, the National Soil Management Handbook, and Tahoe National Forest Land and Resource Management Plan (LRMP), specifically Standard and Guideline (S&G) 55. S&G 55 identifies one indicator, “productivity”, and three metrics soil porosity, soil cover”, and soil organic matter. The potential effects to these parameters are analyzed by the Sagehen Project Soils Resource Effects Analysis Report (incorporated by reference and available upon request), and detailed information regarding the Sagehen Project treatment area soils are included in the project record (available upon request). The Standard Management Requirements (SMR’s) as described in Chapter 1 of the EA, contain specific Best Management Practices (BMP’s) and other measures to protect soil resources and are referenced in this analysis. As no action would occur under Alternative 2, the existing condition of soils would continue in the project area under that alternative; there would be no change due to planned activity for the metrics of compaction, soil cover and organic matter. The potential direct and indirect effects of Alternative 1 and Alternative 3 to soil resources are discussed below.

Direct and Indirect Effects to Soil Cover, Organic Matter and Duff

Under Alternative 1, there are a potential 2,190 acres that may incur some mechanical equipment disturbance and 796 such acres for Alternative 3. Heavy equipment use can affect soil cover and duff and this may occur on skid trails, landings and turning zones on approximately 15 percent of the mechanical treatment units. Only a small portion of these areas are reduced below Effective Soil Cover (ESC) after implementing SMR's. The SMR requirement to meet Forest Plan ESC guidelines is to attain the minimum requirements for erosion control prior to the winter season. Out of these mechanical treatment acres, 976 acres are also exposed to variable potentials for increased ground cover in masticated portions of these units under Alternative 1, and 706 such acres under Alternative 3.

Areas with ground cover and duff levels reduced to mineral soil can also occur in burn piles(mechanical piling and hand piling), . Areas with scattered burn piles will occur over a portion of 1,060 acres for Alternative 1 and 342 acres under Alternative 3. Hand piles would generally take up less than 15 percent of the treatment area and not all piles would reduce existing cover to mineral soil (Hubbert et.al, 2010).. For units proposing to be underburned it is estimated that 60 percent to 80 percent of an activity area would undergo underburning resulting in areas with reduction in ground cover and surface char of duff across those portions of the activity area. There would be areas with reduced levels of pre-existing ground cover and duff through underburning with approximately 1,500 acres potentially affected under Alternative 1 and 900 acres under Alternative 3.

Because each of the activities (mechanical treatments and prescribed fire treatments) within a given treatment unit may be separated by a few to several years, ground cover commonly accumulates prior to implementation of the next phase of the prescription. The BMP's (as displayed in the SMR's) are known to be effective in protecting water quality and preventing erosion, thus soil cover is shown to be effective through this process by controlling erosion (USDA FS PSR, 2009). Although multiple actions may result in various degrees of change in existing soil cover and duff, over the sequence of implementation, the SMRs applied during after each implementation sequence bring the site to minimum standards (average ESC of 50%). Areas of exclusions due to operability or inclusion for DCAs combined with areas of undisturbed duff within the project area would result in maintaining 20 percent undisturbed duff across the activity area. While the various proposed actions have more than one entry that may reduce areas of existing duff depth, there are few activities as a whole which tend to remove duff to the extent that it is reduced to mineral soil over a large extent of the activity area. ESC and duff requirements are designed to meet or exceed S&G#55 and productivity is maintained.

The minimum Forest Plan standard for large woody material includes the smaller logs, merchantable wood, or other woody material at a rate of 200 cubic feet to 800 cubic feet per acre and this equates to approximately 2.3 to 10 tons per acre depending on density. Based on the conservation objectives for large downed wood, Alternative 1 would exceed large wood criteria over 729 acres in emphasis areas 1, 2 and 4. It would meet the large wood criteria over 1,028 acres in emphasis area 5, and meet the objective for tons per acre through smaller logs, merchantable wood, or other woody material on 896 acres in emphasis areas 6, 7, and 8. Under Alternative 3, the units that would be treated are less likely to have large changes to the existing downed wood because the treatment area is limited primarily to

plantations that are already low in large downed wood volumes. A total of 1,131 acres would meet the objective for large wood primarily by meeting tons per acre through smaller logs, merchantable wood, or other woody material. For both Action Alternatives, S&G#55 would be met in regards to conservation of large downed wood and productivity would be maintained.

Under Alternative 1, there would be 3.8 miles of temporary road built on approximately 5.5 acres (with no need for a borrow site) having decreased effective soil cover, duff and large woody material for a period of approximately 5-years until the road is decommissioned. Post-project requirements include pulling the berm where duff and soil was displaced and adding wood chips or mulch from landings and the adjacent project to supplement loss of duff. The linear nature of the road is likely to gain down large woody material from adjacent stands over the mid-term. Alternative 3 does not include temporary road construction.

Restoration activities under Alternative 1 include obliteration of approximately 1 mile of the existing 11-5 road and improvement of soil conditions above a series of small fens and along the terminus of a larger fen that includes approximately 300 ft. of the subject road. These activities would result in short-term disturbance and replacement of soil cover and organic matter over approximately 1.4 acres total. Restoration of these portions of the 11-5 road would be beneficial for soil hydrology and riparian productivity associated with the hydric soil resources. It is estimated that these restoration activities in combination with the aspen treatment (conifer removal), would improve the fen and wetland soil and organic matter in the area surrounding the fen (over approximately three acres) in the long term.

Direct and Indirect Effects to Soil Porosity and Compaction

There would be varying degrees of decreased porosity within mechanical treatment units proposed under Alternative 1 and Alternative 3. Under Alternative 1, 2,190 acres would receive mechanical treatments compared with 706 acres of mechanical treatments under Alternative 3. The highest risk areas for detrimental compaction are over skid trials, landings and heavily tracked areas. Assuming proper implementation of SMR (3) for uplands and (4) and (5) within the RCA where the equipment operations meet the operability criteria for dryness, the degree of detrimental compaction is localized to converging skid trails and landings. Reuse of existing legacy skid trails and landings under SMR (6) and (10) would help limit the extent of porosity impacts and other resource damage. High use areas with the greatest risk for compaction are estimated at 15% of the treatment areas, which is 329 acres for Alternative 1 and 106 acres for Alternative 3. Even the high use areas do not typically exceed the Forest Plan detrimental porosity thresholds in degree over the full extent of the activity areas. (An activity area is the area on which a soil impacting activity has occurred or is planned. Activity areas include Levels of detrimental compaction in degree and extent are designed to meet Forest Plan Standard with proper implementation of the combination of SMR's. Because mechanical treatments in the alternatives include thinning and/or mastication, fewer acres than estimated may actually be exposed to heavy tracking in those areas where mastication only occurs. Additional small areas of pile burning can increase bulk density but preliminary data (Hubbert et.al, 2010) did not provide a range of change that could be related to the Forest Plan Standards and Guides for porosity.

Under Alternative 1, there would be detrimental compaction on temporary roads over 3.8 miles on approximately 5.5 acres (with no need for a borrow site) for a period of approximately 5-years until the road is put to bed. Temporary roads are required to be designed to minimize construction length and width (SMR12) and also follow the provisions of traffic control wet periods SMR(20). Following use these roads would be sub-soiled, and roadside berms with mineral soil are pulled back in; drainage is provided to create a hydrologically neutral state (SMR 21). No temporary roads are proposed under Alternative 3.

Restoration activities described under Alternative 1, which would obliterate approximately 1 mile of the existing 11-5 road, would result in reduced compaction over 1.3 acres following re-contouring of the road bed. During restoration the equipment would be primarily contained within the existing road bed so there would be little potential for expanding the existing compaction during construction. Any staging area would occur over previously disturbed landings, or roads and would be restored by reducing compaction where needed. No restoration activities are proposed under Alternative 3.

Hydrology

This section of the EA summarizes the analysis contained in the Sagehen Project Hydrology Report (February, 2013) hereby incorporated into this document by reference. It presents an analysis of the direct and indirect effects of the proposed action and alternatives on water resources.

Affected Environment

The Sagehen Project area is located in Nevada County west of Highway 89, and north of Truckee. The Sagehen Project area is located within the following watersheds:

- **Little Truckee River Watershed** includes activities within the Sagehen Catchment (Upper and Lower Sagehen Drainage Area), and the Little Truckee River Independence Lake Catchment (Saddle Meadow Drainage Area), draining to Stampede Reservoir.
- **Middle Truckee River** includes the Middle Truckee River Prosser Reservoir (Prosser Creek Drainage Area), draining to Prosser Reservoir.

Land ownership within the Sagehen Project is primarily NFS land with some private inholdings. Upper Sagehen Creek is 84 percent NFS lands and Lower Sagehen Creek is 100 percent NFS lands while Prosser Creek is 95 percent NFS lands. The Saddle Meadow Drainage area is approximately 94 percent NFS lands.

Special Aquatic Features and Special Interest Areas

Areas within the upper portion of the Upper and Lower Sagehen basin have meadows, fens, and wetlands outside of and within proposed treatment units. These Special Aquatic Features (SAF's) are in various stages of health in other words proper hydrologic function. Additionally Special Interest Areas (SIAs) of the Sagehen Basin include the Mason Fen and Sagehen Headwaters. The Mason Fen (30 acres) represents the largest fen in the Sagehen Basin vicinity and has a unique botanical assemblage. The Sagehen Headwaters area (79 acres) is located in an intact glacial cirque basin (Section 16, T .18 N.,

R.15E.). These SIAs are not located within treatment units. Sagehen Creek is recommended as a National Wild and Scenic River with the Scenic Designation applied to eight miles of Sagehen Creek extending over a 1/4 mile-wide strip on each side of the centerline of Sagehen Creek from its headwaters to where it enters Stampede Reservoir. 5.7 miles of Sagehen Creek upstream of Stampede Reservoir is located within the project area. See FONSI Elements 3 and 10 in Chapter 3 for discussions of the status of Sagehen Creek relative to the project alternatives.

Beneficial Uses

The Water Quality Control Plan for the California Water Quality Control Board (LRWQCB) Lahontan Region (LRWQCB, 2000), defines the beneficial uses for the Little Truckee River Drainages, and the Middle Truckee River to include the following: municipal and domestic water supplies (adjacent and downstream), irrigation and water supply for agriculture (adjacent and downstream), groundwater recharge, contact and non-contact recreation (adjacent and downstream), commercial and sportfishing (adjacent and downstream), cold freshwater fisheries and spawning habitat (adjacent and downstream), wildlife habitat, rare, threatened or endangered species habitat (adjacent and downstream). The beneficial uses of the Truckee River Drainage basin also include the migration of aquatic organisms (adjacent and downstream).

The water quality objectives for beneficial uses that could potentially be affected by the Sagehen Project include sediment, temperature and turbidity, also to a lesser degree pesticides (Boron) and controlled use of petroleum based products. The site specific designs incorporating Best Management Practices (BMPs) and other management requirements used to protect natural resources can be found in Chapter (1) of the EA under *Standard Management Requirements* (SMR's) which incorporate Best Management Practices (BMP's) designed to protect the beneficial uses of water.

Water Quality

The Middle Truckee River has been listed by the State of California as being "water quality limited" for sediment under Section 303(d) of the Clean Water Act. Sagehen Creek proper and the Little Truckee River within the Saddle Meadow Drainage and Prosser Creek Drainage area are tributary to the Middle Truckee River main stem. The Truckee River (LWQCB BASIN) and all of its tributaries have been listed as an impaired waterbody (303d) under the Clean Water Act for high amounts of sediment based on a study reporting heavy sediment levels in the main stem of the Middle Truckee River. However, all of the run-off from the drainage areas proposed for treatment under the Sagehen Project alternatives flow through reservoirs prior to entering into the main stem of the Middle Truckee River. Any potential sediment resulting from project alternatives would become trapped in the reservoirs and would not threaten water quality in the main stem of the Middle Truckee River.

Requirements for Water Quality under the Sagehen Project include meeting the conditions to attain a Waiver for Timber Harvest from the Lahontan Regional Water Quality Control Board. All required state and federal permitting processes, such as California Environmental Quality Act (CEQA), any 401 or 404 permits or any prohibition exemptions would be complied with for elements within the proposed

actions which may require these measures in particular any proposed restoration that may require these measures.

The Tahoe National Forest would submit an application for a conditional waiver of waste discharge according to the California Regional Water Quality Control Board - Lahontan Region for activities implemented under the Sagehen Project decision notice where they meet the "general conditions" and comply with the "eligibility criteria" specified in the Lahontan Regional Water Quality Control Board's timber harvest waiver. Any additional information required by the board for clarification would be provided during permit application. Activities implemented would follow the terms and conditions of the approved waiver in compliance with Order number R6T-2009-0029 (includes monitoring requirements, reporting, and an action plan). These commitments would be the means to ensure compliance with the Clean Water Act for covered activities.

At this time, there is uncertainty whether a National Pollution Discharge Elimination System (NPDES) permit would be required for stormwater discharges from logging roads associated with this project. Although the Environmental Protection Agency has published a final rule exempting logging road stormwater discharge from NPDES permitting requirements, the United States Supreme Court is currently reviewing the matter. Until the Supreme Court rules, it will be uncertain whether a NPDES permit is required for this project.

Discussion regarding the site-specific information used to achieve consistency with Forest Plan standards and guidelines for Riparian Conservation Areas (2004 SNFPA ROD, pp. 62 – 66) is included in Appendix D (Riparian Conservation Objectives analysis) of this EA. Detailed discussions regarding direct and indirect effects on hydrologic resources are presented in the Sagehen Project Hydrology Report (December, 2012) and summarized below.

Direct and Indirect Effects

The following discussion addresses mechanisms from the project alternatives that increase the risk for an effect on hydrologic characteristics that could potentially affect beneficial uses and water quality. The proposed mitigations have been shown to be successful through monitoring; therefore, this analysis is conducted based on the increased risk, but assumes mitigations would be implemented. Even with implementation and monitoring, there is a small risk that the implementation measures might not be fully implemented or might not be effective. Potential effects of Alternative 1 are greater than for Alternative 3 across the indicators because Alternative 1 covers a larger area of the landscape. For a detailed analysis of all project activities carried out in RCA's see Appendix E of the EA, "Riparian Conservation Objectives Analysis."

Risk of Boron, Oil and Grease Affecting Water Quality

The degree to which differences between the alternatives would be identifiable for boron, and oil and grease as indicators is small. Boron, and oil and grease have small areas of controlled use under Alternative 1 and Alternative 3 only. Negative effects are usually accident driven, and BMP measures address their controlled use. There would be less risk and fewer areas where boron, oil and grease would pose a threat to water quality under Alternative 3 versus Alternative 1 because of the smaller area of the landscape being treated.

Alternative 1 and Alternative 3

Under Alternative 1, approximately 164 acres would be mechanically thinned and 129 acres manually thinned in SAF and perennial RCA's; under Alternative 3, approximately 57 acres would be mechanically thinned and 80 acres manually thinned in these areas. Applications of Sporax® (boron) would occur on conifer stumps greater than 14 inches dbh. Potential effects from an accidental sporax spill would be minimized through management practices in SMR 13 (Appendix A), which outlines application methods and development of a spill plan. There is some risk for a spill of oil and grease associated with operating mechanical equipment, and to a lesser extent chainsaws within and near the RCA's. Potential effects from a spill would be minimized through management practices in SMR 15, including advance development of a spill plan. Since more acres are treated within and near RCA's under Alternative 1 than under Alternative 3, the risk of a spill under Alternative 1 is slightly higher.

Alternative 2: No Action Alternative.

No applications of Sporax® or equipment use would occur. There would be no risk of a spill.

Risk of Sediment Delivery Resulting from Vegetation Treatments

This section covers risk of sediment transport from the project area based on use of mechanical equipment and prescribed fire within the treatment units. These risks are mitigated through the measures contained within the SMRs (Appendix A) as discussed below.

Mechanized Equipment:

Alternative 1 and Alternative 3

Under these alternatives, use of mechanical equipment would result in areas affected by varying degrees of decreased soil porosity and decreased water infiltration (as discussed under the previous section on soil productivity). Under Alternative 1, approximately 2,190 acres could be potentially affected, while under Alternative 3, 706 acres could be affected. Most areas of decreased porosity would not be associated with notable decreases in infiltration and ground cover, except in heavily used traffic areas (specifically skid trials, landings and heavily tracked areas where skid trails converge). Approximately 15 percent of the activity areas are estimated to be subject to heavy equipment traffic and are at higher risk for effects; this translates to 329 acres for Alternative 1 and 106 acres for Alternative 3. Of the 15 percent of the area identified as higher risk, however, only a small percentage results in notable increased runoff or reduced ground cover that could potentially lead to erosion or sediment transport as estimated according to historical monitoring data.

Under Alternative 1, approximately 427 acres within RCA's are proposed mechanical treatments with 128 such acres under Alternative 3. Heavily tracked areas could be susceptible to increased erosion and sediment transport across mechanical treatment units. Tractor Keep Out areas, slope, moisture and skid trail requirements detailed in SMRs 4, 5, and 7 along with avoidance of landings being placed within RCAs (SMR 11), heavily compacted areas within the RCA's would be minimized. The potential for sediment transport and runoff would also be decreased by providing drainage controls and mulching as

described in SMRs 2, 9, 17 and 23. Heavy use areas would be minimized within RCA's by avoiding excessive skid trial placement within these areas and re-using existing skid trails (SMR 7) and maintaining equipment away from wet soils and the 100-year flood plain (SMRs 2, 17, 18 and 23). Protection for stream channels would be provided through approving stream crossing locations, minimizing the number of stream crossings, and minimizing equipment operations in the near stream zone (SMR 5). Additional means of minimizing impact in the near stream zone would be through project design; in particular some sensitive areas were selected for hand treatment only and others were excluded from treatment altogether. Risks for effects from mechanized equipment are higher under Alternative 1 than under Alternative 3 because of the greater number of acres treated in Alternative 1 and equipment use associated with commercial timber harvest in Alternative 1 that is not included in Alternative 3.

Alternative 2: No Action Alternative.
No mechanized equipment use is proposed under this alternative. There would be no effects related to sediment delivery from use of mechanized equipment.

Prescribed Fire:

Alternative 1 and Alternative 3
Prescribed surface fire could be potentially applied in a total of approximately 282 acres in RCAs under Alternative 1 and 274 acres in RCAs under Alternative 3. SMR 18 requires measures to minimize active fire ignition and protect riparian vegetation within RCAs during application of prescribed surface fire while allowing fire to creep into these areas. Implementation of this SMR would meet ground cover, duff, and down wood retention requirements along with riparian vegetative retention within the RCA. With implementation of SMRs 18 and 17, the potential for a high severity prescribed surface fire that decreased effective soil cover would be reduced, thereby decreasing risk of degradation to the water resource from sediment and maintaining beneficial uses.

Alternative 2: No Action Alternative
Prescribed fire use is not proposed under this alternative. There would be no effects related to sediment delivery associated with application of prescribed fire.

Risk of Sediment Delivery from Temporary Roads
Temporary roads would have short- to mid-term potential for increased sediment production. The degree and extent would be related to timing, intensity and duration of precipitation events over the period of use. Temporary roads would be decommissioned following use and restored to a hydrologically neutral state. Proposed road maintenance, and restoration activities should have some off-setting effects, resulting in maintenance of water quality and the existing contributions of sediment over the mid- term. Mitigations to minimize effects of temporary roads are included in the SMR's in Appendix A (see SMR's 19, 20, 21 and 22). These actions would reduce the risk for water resources degradation from sediment and maintain beneficial uses. Construction and use of temporary roads would occur only under Alterative 1.

Alternative 1: Proposed Action

Alternative 1 includes approximately 3.8 miles of temporary roads with approximately 5.5 acres of disturbance over the project area. . It should be noted that temporary roads as currently mapped are close approximate locations. However, final locations will consider hydrology, slope, soil, and sensitive area restrictions, and will be located in the best available site that maintains water resources and beneficial use. Short segments of mapped temporary roads would cross through RCA areas. There are an estimated 0.27 miles of temporary road through 150 foot RCA buffers on seasonal streams in units 33, 36, 73, and 163. The 0.06 miles in perennial RCA falls within unit 163 at the very upper perimeter of the 300 foot RCA around a stream flowing from a perennial spring. The 0.26 miles in meadow RCAs includes approximately 0.1 miles in unit 163 at the very upper perimeter of the 300 foot RCA around the meadow system supported by the perennial spring. The remaining 0.16 miles is located in the upper end of unit 33 where the RCA is associated with a meadow, however this temporary road, while still in the 300 foot RCA, is located in an upland, dry site. Overall, effects in these RCAs from temporary roads are expected to be minimal because the roads will be located in the best available site and the design features will protect resources. The mitigations associated with temporary roads are included in SMRs (19, 20, 21 and 22) and incorporate standard temporary road BMPs. In addition, there would be a closure on the temporary road in unit 163 which will preclude access when the road is not being used for project activities. At the end of project use, these temporary roads would be sub-soiled and obliterated, and mulch and organic matter would be re-incorporated into the surface soils.

Monitoring has shown that Best Management Practices are effective in reducing levels of sediment transport. The 2010 Herger-Feinstein Quincy Library Group (HFQLG, 2010) BMP monitoring showed that, where road drainage is provided with 100 percent implementation, up to 96 percent effectiveness was attained. These results also showed where effectiveness was not attained, sediment did not reach the stream. Hence, the magnitude and extent of impacts for cases that are not effective are shown to be minor when BMPs are implemented. Monitoring has shown that BMP measures have achieved 100 percent effectiveness on road decommissioning.

Alternative 2: No Action Alternative

No temporary roads would be constructed under this alternative. There would be no increased risk of sediment transport from temporary roads under this alternative.

Alternative 3: Non -Commercial Funding

No temporary roads would be constructed under this alternative. There would be no increased risk of sediment transport from temporary roads under this alternative.

Risk of Sediment Delivery from Hauling Forest Materials on Existing Roads

In addition to the temporary roads described above, existing roads will be used to haul forest materials off-site for processing during project implementation under Alternatives 1 and 3. During the time periods when increased traffic and haul maintenance occur, risk of sediment transport and delivery from the haul roads is higher. Maintenance measures, such as grading, tend to cause an initial increase in

sediment transport in the short term (one to three runoff events following grading). However, maintenance measures and proper drainage design, where appropriately implemented, can reduce the potential for large sediment pulses from precipitation events. In order to maintain water quality, maintaining the function of cross drains on existing road segments following implementation of project activities would be a requirement of the contract, while waterbars and other water means of minimizing road water connectivity would be applied to control water and sediment contributions during the wet seasons in areas under ongoing activities. Monitoring has shown where BMPs are implemented, effectiveness can attain 96 percent where sediment delivery from roads is controlled (HFQLG, 2010). Additionally, based on the 2010 HFQLG BMP monitoring, sediment did not reach the streams. So the magnitude and extent of impacts for cases that were ineffective were shown to be minor within 2 years after BMP implementation. The SMR's in Appendix A (see SMR's 19-22) incorporate BMP's and design measures to reduce the risk of increased sediment resulting from hauling forest materials on existing roads under Alternative 1 and Alternative 3, thereby maintaining beneficial uses.

Alternative 1: Proposed Action

Approximately 22.4 miles of road would be maintained for haul. These roads have a potential increased risk of sediment transport and delivery to stream channels up until the first significant runoff producing event. Approximately 8.2 miles of the roads proposed for transportation are located within an RCA. Under this Alternative, there are 85 seasonal stream crossings and 2 perennial stream crossings that would be used on the existing transportation system. These road crossings could be susceptible to increased levels of sediment transport.

There are two primary factors that can contribute to increased risk of sediment delivery associated with haul: (1) travel on native surfaced roads during dry periods can be reduced to dust that is more easily transported during a runoff producing event where there is no proceeding non-runoff wetting precipitation, and (2) travel over wet roads can tend to deform the road surface and/or attached road surface particles can be transported with the wheel of the vehicle leading to a potential increase in sediment transport and is particularly tied to stream crossings.

Abatement measures for the two afore mentioned factors are included in SMR 20, which includes: (1) "Road dust abatement" for haul roads and provides measures for wetting roads and retains road surface cohesion; (2) "Traffic control during wet periods," which decreases the potential of direct transport to crossings and minimizes rutting and deformation of the road surface; and (3) "Low water crossings" design requirements during haul reduce the levels of wheeled transport directly to class I and class II waterbody stream class drainages. These measures are designed to minimize sediment delivery to the streams. With pre-haul maintenance, some aspects of existing road condition, particularly areas with rutting and potholes would be improved, and would be maintained during haul. After implementation, the operator would be responsible to attain pre-haul road conditions.

Alternative 2: No Action Alternative

No increased use of existing roads for transport or haul would occur. There would be no increased potential for sediment transport beyond existing trends.

Alternative 3: Non -Commercial Funding Alternative
Approximately 7.24 miles of road would be maintained for haul. These roads have a potential increased risk of sediment transport and delivery to stream channels. Approximately 6.4 miles of the roads proposed for transportation are located within an RCA. The road stream crossings used on the haul route include 48 seasonal stream crossings. These road crossings could be susceptible to increased levels of sediment transport. With pre-haul maintenance, some aspects of existing road condition, particularly areas with rutting and potholes would be improved and would be maintained during haul. After implementation, the operator would be responsible to attain pre-haul road conditions by restoring crossings, dips, and water bars and cleaning culverts (SMR 20). The risk of effects from increased sediment delivery would be less under Alternative 3 than under Alternative 1 because less miles of road would be maintained and used for haul.

Effects of Legacy Road Restoration
Under Alternative 1, one mile of legacy road restoration is proposed to improve hydrologic function and connectivity and remove three stream crossings. Actions from past activities have resulted in rerouted hydrology, lowered water tables and altered or disconnected hydrology to mesic features that may be affecting springs, meadows, fens or wetlands.

There would be a short-term reduction in soil cover associated with restoration activities for access and where disturbance would be needed to meet objectives for restoration. These areas could lead to sediment contributions if exposed to concentrated water and runoff results. As described in the proposed action in Chapter 2, mitigation measures would be implemented to provide soil cover and meet permitting requirements for compliance with sections 401 and 404 of the Clean Water Act.

Alternative 1: Proposed Action
Approximately 1 mile of existing roads, which currently have an increased risk of sediment transport and delivery to stream channels, would be restored. The proposed action would reduce the miles of road within RCA's by 0.56 miles with a majority of the area in SAF RCA and a small component of perennial and seasonal RCA. The removal of this road would also result in reduction of 3 road stream crossings on seasonal drainages. The hydrologic connectivity of surface and subsurface flows around these features would be restored.

Alternative 2: No Action Alternative
No restoration would occur. Existing trends and conditions of sediment transport would continue.

Alternative 3: Non -Commercial Funding
No restoration would occur. Existing trends and conditions of sediment transport would continue.

Summary of Effects in Riparian Conservation Areas (RCAs)

The overall project design for proposed treatments in RCA's is based on minimizing disturbance of the near-stream environment, including riparian vegetation, soils, and other aquatic habitat elements. The use of manual treatment methods instead of mechanical methods associated with equipment use reduces the risk of impacts in several locations. Out of 665 acres of treatments in RCA's, approximately 36 percent of the acres (237 acres) would be treated under manual means and include a pile burning or surface fire prescription under Alternative 1. Under Alternative 3, out of 348 acres of proposed treatments in RCA's, approximately 63 percent of the acres (220 acres) would be treated under manual means and include a pile burning or surface fire prescription. Most mechanically treated units in RCA's are associated with seasonal drainages where sediment delivery risk is decreased. Resource protection measures in mechanical treatment units include restricting mechanical equipment use through equipment restrictions, such as Tractor Keep Out areas (TKO's) that designate the distance tracks of equipment are to be maintained away from riparian features. For more detailed descriptions of resource protection measures in RCA's refer to the SMR's listed in Appendix A. The RCO analysis, Appendix D, contains further discussion on how resource protection standards are met within RCA's to maintain beneficial uses of waters adjacent and downstream of the project area.

Wildlife

This section of the EA analyzes potential effects of the Sagehen Project on Federally listed and Forest Service sensitive terrestrial wildlife species. An account of potential effects to terrestrial wildlife Management Indicator Species is incorporated at the end of this section. A Biological Evaluation / Biological Assessment (BE/BA) report for terrestrial wildlife species was prepared for the Sagehen project (February, 2013), is hereby incorporated into the EA by reference and serves as the basis for the following analysis; the report is part of the Sagehen Project record and is available on request from the Tahoe National Forest.

Table 3.6 below summarizes the species analyzed and their respective listing status. The table includes United States Department of Interior Fish and Wildlife Service (USFWS) threatened, endangered, candidate, and proposed species maintained at 50 CFR 17.11 (updated September 18, 2011 and reported November 8, 2012), and United States Department of Agriculture Forest Service Region 5 Forester's (USFS R5) Sensitive Species, listed for Tahoe National Forest (Updated as of June 8, 1998, Appended March 6, 2001, May 7, 2003, April 21, 2004, March 3, 2005, October 15, 2007)

Table 3.6.

TERRESTRIAL SPECIES	
Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus*	USFWS Threatened
Bald eagle, *Haliaeetus leucocephalus*	USFS R5 Sensitive (TNF)
California spotted owl, *Strix occidentalis occidentalis*	USFS R5 Sensitive (TNF)
Great gray owl, *Strix nebulosa*	USFS R5 Sensitive (TNF)
Northern goshawk, *Accipter gentilis*	USFS R5 Sensitive (TNF)
Willow flycatcher, *Empidonax trailii* subspecies *brewsteri* on the west slope of the Sierran Crest and subspecies *adastus* on the east slope	USFS R5 Sensitive (TNF)
Greater sandhill crane, *Grus canadensis tabida*	USFS R5 Sensitive (TNF)
Pacific fisher, *Martes pennant*	USFS R5 Sensitive (TNF)

	USFWS Candidate
Pacific Marten, *Martes americana*	USFS R5 Sensitive (TNF)
Sierra Nevada red fox, *Vulpes vulpes necator*	USFS R5 Sensitive (TNF)
California wolverine, *Gulo gulo luteus*	USFS R5 Sensitive (TNF) USFWS Candidate
Pallid bat, Antrozous pallidus	USFS R5 Sensitive (TNF)
Townsend's big-eared bat, *Corynorhinus townsendii*	USFS R5 Sensitive (TNF)
Western red bat, *Lasiurus blossevillii*	USFS R5 Sensitive (TNF)

Species and Habitats Not Affected by Sagehen Project

No effects will result from implementation of the Sagehen Project to species that do not occur or do not have suitable habitat within the analysis area. Species presented below in Table 3.7 do not occur or have no suitable habitat within the analysis area, will not be affected by implementation of either of the action alternatives, and are not analyzed further. A rationale for each determination is also given in Table 3.7.

Table 3.7. Species eliminated from further analysis for the Sagehen Project.

SPECIES	SPECIES STATUS[1]	EFFECTS DETERMINATION[2]	RATIONALE FOR DETERMINATION
Valley elderberry longhorn beetle	T	No Effect	Analysis area outside the range for this species (above 3,000 feet)
Pacific fisher	FSS, C	No Effect	Analysis area outside the known distributional range for this species (above 5,000 feet)
Sierra Nevada red fox	FSS	No Effect	Outside the known distributional range for this species.
Greater sandhill crane	FSS	No Effect	Nearest breeding population outside of analysis area.
Western red bat, Townsend's big-eared bat, pallid bat	FSS	No Effect	Outside the known distributional range and/or no suitable habitat for these species

[1]Forest Service Sensitive (FSS), U.S. Fish and Wildlife Service Endangered (E), Threatened (T), Proposed (P), or Candidate (C) species.

Metrics for Analyzing Direct and Indirect Effects

Direct Effects: Direct effects are potential impacts that could affect the distribution, abundance, and reproductive status of wildlife species through direct disturbance associated with proposed activities within or adjacent to the project treatment units. Known species distribution and reproductive status were identified for the analysis area using the Forest Service NRIS database, CNDDB, Tahoe NF GIS layers, and other relevant data collected by researchers and other individuals. Species locations, reproductive status, and proximity to project alternative activities are described for determining potential direct effects.

Indirect Effects - Indirect effects to terrestrial wildlife habitat quality and quantity were analyzed by using current Forest Service vegetation maps with attributes of the California Wildlife Habitat Relationships (CWHR) vegetation classification system. The CWHR habitat types and structural classes were designed to correlate with forest inventory data used by the USDA Forest Service, specifically relative to the project alternatives potential to affect tree size and canopy cover density classes. The CWHR system was developed to categorize major vegetative complexes at a scale sufficient to predict wildlife-habitat relationships, and has been a widely accepted approach for describing and analyzing changes to wildlife habitats at the project and broader landscape scales. The Forest Vegetation Simulator (FVS) model was used to predict post-treatment tree size class and canopy cover density. While the CWHR system provides a useful and relative measure to track changes from treatments to habitat quantity, it is limited in its ability to describe habitat quality, particularly in terms of habitat diversity and structural complexity, particularly where understory and structural complexity can be reduced or eliminated from fuels treatments such as underburning. Therefore, a qualitative narrative summary is also used to provide a description of post project effects of the proposed activities on habitat diversity and structural complexity, forest resiliency and climate change, and forest connectivity and fragmentation.

Snags and down logs are important habitat components particularly for late-seral associated species such as the Pacific marten, Northern goshawk and the California spotted owl for nesting, roosting, and denning. The FVS model was used to predict the amount of snags and down logs that would be affected by project alternatives. However, the FVS model does not account the project's Decadent Feature Enhancement treatments whereby snags would be created through partial girdling and topping trees to create short snags for roosting and denning. Therefore, both a quantitative and qualitative description of snags and down logs is appropriate for analyzing impacts from project alternatives.

Effects Common to All Wildlife Species

No Action Alternative (Alternative 2)

Direct Effects: There would be no direct effects to Sensitive wildlife species, since none of the activities proposed for the action alternatives would occur.

Indirect Effects: Past large uncharacteristically severe wildfires (specifically the Donner Ridge and Independence), combined with reforestation efforts 50 years ago, have resulted in the extensive Jeffrey and ponderosa pine plantations that currently occupy the southeastern, northeastern, and northwestern areas of the Sagehen Basin. Dense second growth conifer stands occupy much of the remainder of the Basin and fire has been excluded from these natural stands for decades. Past fires, reforestation, timber harvesting, and fire exclusion have combined to create today's simplified, relatively homogenous structure of the plantations and many of the Basin's forest stands.
The structure and tree species composition of the plantations and many of the Basin's forest stands have made them vulnerable to a host of mortality factors, including drought stress, bark beetle outbreaks, disease, and the over-arching ramifications of climate change. Excessive tree mortality can have significant and long-term effects on forest structure and composition, and these conditions can exacerbate the threat of severe fire. Climate change is anticipated to aggravate these stressors.

The No Action Alternative would not change the quality or quantity of wildlife habitat in the short term, nor the distribution of seral stages that are currently present. If no action occurred within the Sagehen Basin, there would be an increase in the susceptibility of wildlife habitat loss to disturbances such as fire, insect, and disease outbreaks over time as fuel loadings continue to increase due to conifer mortality and increasing stand densities. If a stand-replacing fire were to occur in the next 25 years, it would likely replace mid- to late-successional habitat that is presently available to late-successional-associated sensitive species—the California spotted owl, Northern goshawk, Pacific marten—with early-successional shrub habitat, which would be detrimental to the majority of sensitive species and other species of concern in the project area. Early successional associated species would benefit from fire, by improving foraging opportunities for shrub-dependent species over the next 10 to 25 years. This could indirectly benefit species such as the wolverine and Sierra Nevada red fox, by improving habitat for prey species by creating browse for deer and forage for small mammals

Effects of the Action Alternatives (1 and 3)

Direct Effects: Direct effects to wildlife occur from disturbing, injuring or killing individuals. Noise from operating motorized equipment during project implementation, or smoke from prescribed burning, has the potential to directly affect wildlife by displacing individual animals from the vicinity of project treatment units. The proposed project cover a total of 2,654 acres (9%) out of the 29,467-acre analysis area that include a variety of types of activities—variable thinning, legacy tree treatment, dense cover areas, early seral openings, underburning, suppressed cutting, mastication, and snag creation. Individual projects are typically implemented over a five to ten-year period, which spreads out disturbances both spatially and temporally within any one location. This further limits the area affected by disturbances of the analysis area in any individual year. Noise disturbing effects are temporary, lasting several months during the year when they are implemented. If needed, limited operating periods are included in the management requirements to protect California spotted owl and northern goshawks that have active nests or roosts within 0.25 miles of project-related noise disturbances, to reduce the potential for disrupting breeding and reproduction in the project area.

Indirect Effects: Indirect effects to wildlife may occur from altering the quantity or quality of habitat. In both of the action alternatives the fuels reduction proposals include removing trees less than 10” dbh and shrubs using a variety of methods--hand cutting, piling and burning, mastication, and underburning with prescribed fire.

The fuels treatments would reduce the shrub component immediately post-treatment, but within five years, shrubs would re-sprout. Newly sprouting shrubs provide high quality browse for deer, and shrub seeds and herbaceous vegetation provide food and shelter for rodents such as woodrats, mice and squirrels, which are prey species that support numerous sensitive species such as spotted owls, goshawk, marten, fisher, and the Sierra Nevada red fox.

CWHR habitat types are used to describe suitable habitat based upon the Sierra Nevada Forest Plan Amendment Record of Decision (SNFPA ROD 2001, 2004). Proposals to hand cut, pile and burn smaller diameter trees, masticate under-story vegetation, and prescribed burn, are not expected to change California Wildlife Habitat Relationships (CWHR) classification types. Studies have shown that small

mammals (woodrats, deer mice) quickly repopulate burned areas, provided there are nearby unburned understory vegetation to provide source populations. Masticating and burning may reduce small mammal populations in the first year or two, but populations are expected to readily recover thereafter. Therefore, effects to small mammal populations are limited in scope, both spatially and temporally. Implementing projects using a variety of techniques (masticating, prescribed fire, hand cutting, thinning) varies the types of effects spatially throughout the watershed, and implementing projects with appropriated funding distributes these effects temporally, because not all projects in the watershed are fully funded in any given year.

The action alternatives would develop forest stands that would be more resilient to the array of threats. These efforts will enhance forest heterogeneity at both the stand- and landscape-scale; reducing stand densities in certain locations; and modifying tree species composition, for example, favoring more fire resilient pines on south facing slopes, could address these potential sources of mortality. Reducing stand densities would result in less competition for soil moisture resources and light, which would help accelerate the development of stands comprised of larger trees. By creating a more heterogeneous landscape, remaining trees and stands would be better able to cope with drought stress, insect infestation, and disease outbreaks.

Snags and Downed Logs (California Spotted Owl, Goshawk, and Pacific Marten)

Large snags and downed logs provide nesting, resting, and sheltering structures for spotted owls, goshawk, and forest carnivore species and their prey, including cavity-nesting birds and small mammals. Downed logs provide nutrient cycling, maintain soil moisture and provide microclimates for fungi; and fungi are an important food source for small rodents which are the primary prey for many wildlife species. For the action alternatives, the existing snags would be retained, except for snags that pose a hazard or snags that need to be removed for operability.

Alternatives 1 and 3 propose underburning within 643 acres (15%) of mid-seral closed-canopy forests. Prescribed burning is only proposed where existing conditions indicate a high probability of successfully retaining post-treatment stand conditions that are desirable for older forests. Burning prescriptions are developed to minimize the loss of large trees, large downed logs, and large standing snags where practical and where firefighter safety is not compromised. Prescribed burning as proposed would affect only 30% of the treatment units in a manner which would create a mosaic leaving patches of burned and unburned vegetation and woody debris. Some existing snags and down logs would be consumed by the fire, and some trees would likely die from additional stresses from burning. Dead trees would be recruited as snags in the future, and subsequently down logs.

Stephens and Moghaddas (2005) found that use of prescribed fire increased the density of snags greater than 15 cm DBH, and did not significantly alter coarse woody debris in decay classes 1 and 2. In the same study by Stephens and Moghaddas (2005), fire reduced coarse woody debris in decay classes 3 and 4. The use of prescribed fire will increase the forest resiliency to catastrophic loss in a wildfire, and it re-introduces fire back into the system as a dynamic process.

The Forest Vegetation Simulator (FVS) model was used to project snags per acre for snags at 15-30 inch dbh and >30 inch dbh for current conditions, predicted at 30 years, and predicted at 50 years after present for the alternatives by unit and emphasis area from (Table 3.8). The number of partial girdled trees inside and outside Dense Cover Areas (DCAs) and the number of short snags created for the alternatives is also displayed in Table 3.8.

In general, the Forest Vegetation Simulator model indicates that Alternative 1, the Proposed Action, would result in fewer snags per acre compared to both Alternatives 2 and 3, since thinning would remove some recruitment snags. Alternative 2 would result in more snags compared to Alternative 3, since some units would be treated. For example, Unit 36 currently has 6.6 snags/acre that are 15-30 inch dbh and 1.3 snags/acre that are >30 inch dbh. Snag estimates for this unit 30 years post-treatment are projected to be 2.1/acre in the 15-30 inch dbh size class and 0.9/acre in the >30 inch dbh size for Alternative 1. At 30 years, snag densities in Unit 36 would be 15 snags/acre and 1 snag/acre, respectively under Alternatives 2 (no action) and Alternative 3 (no treatments would be conducted in Unit 36 under Alternative 3. However, the Forest Vegetation Simulator model does not account for snags developed through short snag creation or partially girdling under Alternative 1. Alternative 1 proposes to partially girdle 21 trees and create 9 short snags in Unit 36 specifically to enhance snag habitat for wildlife, including marten, spotted owl, and goshawk. This would increase projected snag densities by another 0.3 snags/acre for a short term benefit to species requiring snags within Unit 36. Table 3.8 below show numbers of snags currently and projected over time (30 and 50 years), girdled trees and short snags to be created by alternative across the treatment units.

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
Alternative 1												
33	118	1	4	1.64	0	3.37	.05	6.66	.25	7	1	2
		4	30	1.64	0	1.76	.03	6.03	.23	0	0	6
		5	28	1.64	0	1.72	.03	3.93	.16	36	2	4
		6	56	1.64	0	1.6	.03	2.58	.12	0	2	2
Average Snags/Acre				1.64	0	2.11	0.04	4.8	0.19	-	-	-

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
33	118	1	4	1.64	0	14.85	.12	17.49	.44	0	0	0
		4	30							0	0	0
		5	28							0	0	0
		6	56							0	0	0
Alternative 1												
34	68	5	16	1.18	0	1.92	.05	5.08	.18	0	0	3
		6	47	1.18	0	1.72	.06	2.53	.12	0	0	2
		7	5	1.18	0	1.72	.06	2.53	.12	0	0	0
Average Snags/Acre				1.18	0	1.79	0.06	3.38	0.14	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
34	68	5	16	1.18	0	10.59	.09	15	.36	0	0	0
		6	47							0	0	0
		7	5							0	0	0
Alternative 1												
35	64	1	8	2.12	1.26	1.82	.93	2.77	.75	6	1	2
		4	6	2.12	1.26	1.52	.94	1.19	.78	0	0	1
		5	7	2.12	1.26	1.77	.93	2.34	.74	7	1	1
		6	37	2.12	1.26	1.77	.93	2.34	.74	0	0	1
		7	6	2.12	1.26	1.63	.94	2.14	.77	0	0	0
Average Snags/Acre				2.12	1.26	1.7	0.93	2.16	0.76	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
35	64	1	8	2.12	1.26	9.99	1.22	13.51	1.37	0	0	0
		4	6							0	0	0
		5	7							0	0	0
		6	37							0	0	0
		7	6							0	0	0
Alternative 1												
36	101	4	18	6.63	1.26	2.32	.93	6.23	.81	0	0	6
		5	13	6.63	1.26	2.32	.93	6.23	.81	20	1	2
		6	56	6.63	1.26	1.82	.92	4.46	.79	0	0	1
		7	14	6.63	1.26	1.83	.93	2.2	.73	0	0	0
Average Snags/Acre				6.63	1.26	2.07	0.93	4.78	0.79	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
36	101	4	18	6.63	1.26	14.89	.98	19.28	.94	0	0	0
		5	13							0	0	0
		6	56							0	0	0
		7	14							0	0	0
Alternative 1												
38	210	1	67	3.53	0	3.35	.06	2.84	.09	0	0	19
		4	7	3.53	0	3.03	.07	3.47	.12	0	0	1
		5	86	3.53	0	2.91	.07	3.27	.13	0	0	9
		7	50	3.53	0	2.81	.07	3.01	.14	0	0	0
Average Snags/Acre				3.53	0	3.03	0.07	3.15	0.12	-	-	-

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
38	210	1	67	3.53	0	7.95	.04	16.02	.24	0	0	0
		4	7							0	0	0
		5	86							0	0	0
		7	50							0	0	0
Alternative 1												
39	32	5	32	4.74	0	6.54	0	12.96	0	0	0	0
		Average Snag/Acre		4.74	0	6.54	0	12.96	0	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
39	32	5	32	4.74	0	8.44	0	18.73	0	0	0	0
Alternative 1 & Alternative 3												
46	621	4	47	.38	0	.31	.01	2.81	.01	0	0	0
		5	431	.38	0	.44	0	2.24	0	0	0	0
		6	105	.38	0	.44	0	2.24	0	0	0	0
		7	38	.38	0	.44	0	2.24	0	0	0	0
		Average Snags/Acre		.38	0	0.41	0	2.38	0	-	-	-
Alternative 2 (no action)												
46	621	4	47	.38	0	.66	0	5.42	0	0	0	0
		5	431							0	0	0
		6	105							0	0	0
		7	38							0	0	0
Alternative 1 & Alternative 3												

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
47	33	5	33	.38	0	.44	0	2.24	0	0	0	0
Average Snags/Acre				.38	0	.44	0	2.24	0	-	-	-
Alternative 2 (no action)												
47	33	5	33	.38	0	.66	0	5.42	0	0	0	0
Alternative 1 & Alternative 3												
61	20	1	15	2.82	2.53	6.37	1.83	13.71	1.39	0	0	0
		2	5	2.82	2.53	6.37	1.83	13.71	1.39	0	0	0
Average Snag/Acre				2.82	2.53	6.37	1.83	13.71	1.39	-	-	-
Alternative 2 (no action)												
61	20	1	15	2.82	2.53	17.23	1.84	16.92	1.38	0	0	0
		2	5							0	0	0
Alternative 1												
73	144	4	6	6.49	.63	3.10	.53	2.62	.45	0	0	2
		5	107	6.49	.63	3.04	.53	2.56	.46	0	0	16
		6	27	6.49	.63	2.96	.53	2.37	.46	0	0	1
		7	4	6.49	.63	2.83	.53	2.22	.47	0	0	0
Average Snags/Acre				6.49	.63	2.98	0.53	2.44	0.46	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
73	144	4	6	6.49	.63	13.19	.60	16.41	.89	0	0	0
		5	107							0	0	0
		6	27							0	0	0

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
		7	4							0	0	0
Alternative 1 & Alternative 3												
76	91	4	4	.06	1.08	.50	.86	2.55	.68	0	0	0
		5	37	.06	1.08	.52	.86	.86	.66	0	0	0
		6	42	.06	1.08	.52	.86	.86	.66	0	0	0
		7	8	.06	1.08	.52	.86	.86	.66	0	0	0
		Average Snags/Acre		.06	1.08	0.52	0.86	1.28	0.67	-	-	-
Alternative 2 (no action)												
76	91	4	4	.06	1.08	1.7	.80	2.79	.63	0	0	0
		5	37							0	0	0
		6	42							0	0	0
		7	8							0	0	0
80	5	8	5	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0
Alternative 1												
85	64	5	10	3.01	0	1.74	.01	2.49	.08	11	1	1
		6	53	3.01	0	1.73	.01	2.57	.08	0	0	2
		8*	1	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0
		Average Snags/Acre		3.01	0	1.51	.01	1.13	.08	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
85	64	5	10	3.01	0	6.06	.02	13.08	.19	0	0	0
		6	53							0	0	0
		8	1							0	0	0

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
Alternative 1												
87	207	5	67	0	0	.21	0	2.7	0	0	0	0
		6	130	0	0	.21	0	2.7	0	0	0	0
		7	10	0	0	.21	0	2.7	0	0	0	0
Average Snags/Acre				0	0	.21	0	2.7	0	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
87	207	5	67	0	0	.26	0	4.81	0	0	0	0
		6	130							0	0	0
		7	10							0	0	0
Alternative 1												
89	34	4	6	1.24	.01	3.88	.06	7.2	.06	0	0	2
		6	28	1.24	.01	3.31	.05	5.54	.06	0	0	1
Average Snags/Acre				1.24	.01	3.6	0.06	6.37	.06	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
89	34	4	6	1.24	.01	9.9	.06	15.14	.10	0	0	0
		6	28							0	0	0
Alternative 1												
90	40	6	40	4.25	0	2.10	.07	4.67	.11	0	0	1
Average Snags/Acre				4.25	0	2.10	0.07	4.67	0.11	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
90	40	6	40	4.25	0	16.31	.08	18.76	.19	0	0	0

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
Alternative 1 & Alternative 3												
91	9	2	9	3.68	0	13.2	.01	14.55	.02	0	0	0
Average Snags/Acre				3.68	0	13.2	0.01	14.55	0.02	-	-	-
Alternative 2 (no action)												
91	9	2	9	3.68	0	16.32	.01	14.86	.02	0	0	0
Alternative 1 & Alternative 3												
98	63	1	43	.06	0	2.67	0	11.95	.03	0	0	0
		2	9	.06	0	2.67	0	11.95	.03	0	0	0
		5	11	.06	0	2.67	0	11.95	.03	0	0	0
Average Snag/Acre				0.06	0	2.67	0	11.95	.03	-	-	-
Alternative 2 (no action)												
98	63	1	43	.06	0	4.59	.01	14.09	.03	0	0	0
		2	9							0	0	0
		5	11							0	0	0
Alternative 1 & Alternative 3												
99	67	1	7	0	0	4.6	0	19.65	0	0	0	0
		2	4	0	0	4.6	0	19.65	0	0	0	0
		4	11	0	0	4.6	0	19.65	0	0	0	0
		5	37	0	0	4.04	0	18.11	0	0	0	0
		6	8	0	0	4.04	0	18.11	0	0	0	0
Average Snags/Acre				0	0	4.38	0	19.03	0	-	-	-
Alternative 2 (no action)												

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
99	67	1	7	0	0	9.78	0	19.7	0	0	0	0
		2	4							0	0	0
		4	11							0	0	0
		5	37							0	0	0
		6	8							0	0	0
Alternative 1 & Alternative 3												
100	120	1	14	1	.02	1.4	.21	2	.28	48	2	0
		2	19	1	.02	1.4	.21	2	.28	36	1	0
		4	17	1	.02	1.4	.21	2	.28	0	0	0
		5	46	1	.02	1.42	.22	1.77	.29	0	0	0
		6	24	1	.02	1.42	.22	1.77	.29	0	0	0
Average Snags/Acre				1	0.02	1.41	0.21	1.91	0.28	-	-	-
Alternative 2 (no action)												
100	120	1	14	1	.02	3.65	.26	10.73	.73	0	0	0
		2	19							0	0	0
		4	17							0	0	0
		5	46							0	0	0
		6	24							0	0	0
Alternative 1												
156	84	1	84	5.67	1.27	5.97	.96	10.23	.89	0	0	0
Average Snags/Acre				5.67	1.27	5.97	0.96	10.23	0.89	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
156	84	1	84	5.67	1.27	18.49	1.03	22.97	1.03	0	0	0
Alternative 1												
163	82	1	29	2.23	0	3.45	.09	4.85	.30	0	0	8
		5	49	2.23	0	3.45	.09	4.85	.30	0	0	5
		7	4	2.23	0	3.16	.10	3.20	.24	0	0	0
Average Snags/Acre				2.23	0	3.35	0.09	4.3	0.28	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
163	82	1	29	2.23	0	12.74	.14	17.68	.66	0	0	0
		5	49							0	0	0
		7	4							0	0	0
Alternative 1												
213	268	1	182	2.7	0	4.56	.10	11.55	.90	237	14	30
		2	11	2.7	0	3.13	.08	3.89	.35	32	1	2
		4	21	2.7	0	2.96	.08	3.49	.33	41	3	6
		5	18	2.7	0	3.13	.08	3.35	.31	32	1	2
		6	25	2.7	0	2.96	.08	3.49	.33	0	0	1
		7	11	2.7	0	2.8	.08	3.23	.31	0	0	0
Average Snags/Acre				2.7	0	3.26	0.08	4.83	0.42	-	-	-
Alternative 2 (no action) & Alternative 3 (no treatment in this unit)												
213	268	1	182	2.7	0	23.7	.34	24.02	1.34	0	0	0
		2	11							0	0	0
		4	21							0	0	0

Table 3.8. Current Snags/Acre, Projected Snags/Acre at 30 and 50 years Post-Treatment, Number of Partial Girdled Trees, and # Short Snags Created by Unit and Emphasis Area

Unit	Total Acres	Emphasis Area	Unit Emphasis Area Acres	Current (2012) Snags/Acre 15-30" dbh	Current (2012) Snag/Acre >30"dbh	Projected (2042) Snags/Acre 15-30"dbh	Projected (2042) Snags/Acre >30"dbh	Projected (2062) Snags/Acre 15-30"dbh	Projected (2062) Snags/Acre >30"dbh	# of Partial Girdled Trees Created outside DCA	# of Partial Girdled Trees Created inside DCA	# of Short Snags Created
		5	18							0	0	0
		6	25							0	0	0
		7	11							0	0	0
Alternative 1 & Alternative 3												
282	108	2	46	3.49	.03	4.57	.20	6.37	.40	0	0	0
		6	62	3.49	.03	3.09	.19	2.85	.27	0	0	0
Average Snags/Acre				3.49	0.03	3.83	0.2	4.61	0.34	-	-	-
Alternative 2 (no action)												
282	108	2	46	3.49	.03	14.19	.37	14	.70	0	0	0
		6	62							0	0	0

Dense Cover Areas and Early Seral Openings

Dense cover areas (DCAs) and early seral openings (ESOs) were delineated across proposed treatment units based on topography, forest conditions, literature, professional opinion, collaboration effort and on the ground conditions. In general, the emphasis areas with a higher proportion of larger and denser trees have a higher proportion of DCAs specifically designed to meet the needs for mature and late-seral species, such as the marten, spotted owl, and goshawk. As displayed in the table below, there is a greater proportion of DCAs in emphasis areas 1, 2, 4, and 5 where greater basal area and denser forest conditions on north-facing slopes and canyon bottoms are found compared to emphasis areas 6 and 7 on southern aspects and ridgetops. For emphasis areas 1, 2, 4, and 5, DCAs range from 5% to 11% of the total emphasis area acres. In addition, the variable thinning prescription would provide additional patches of denser patches of trees that would be retained on the landscape, but these microsite conditions may be under-represented due to the course nature of the CWHR classification available to describe changes to vegetation. Post-treatment monitoring by using techniques, such as LiDAR (Garcia-Feced et al. 2011) and WorldView II imagery, would better identify the distribution of these microsite conditions of denser and larger patches across the landscape scale. Alternatively, few acres of DCAs are

delineated within emphasis areas 6 and 7 where conditions are generally more open and fewer large trees are found. Similarly, a lower proportion of ESOs are proposed within emphasis areas 1, 2, 4, and 5 ranging from 0% to 3%. Whereas, ESOs proposed within emphasis areas 7 and 8 would be 4% and 7%, respectively.

Table 3.9 Percentage of DCA and ESO by Emphasis Area.

Emphasis Area	% DCA of total area	% ESO of total area
1	11%	3%
2	6%	0%
4	9%	0%
5	5%	3%
6	4%	4%
7	0	7%
8	n/a	n/a

Species Specific Potential Effects

BALD EAGLE

Status: USFS R5 Sensitive

The bald eagle was listed as an endangered species south of latitude 40 degrees north in 1967 (the "southern" bald eagle; listed under the Endangered Species Preservation Act of 1966), was listed as endangered in most of the lower 48 states in 1978 (threatened in five States and not listed in Alaska or Hawaii), was reclassified to threatened in all lower 48 states in 1995, and was removed (delisted) from the USFWS List of Threatened and Endangered Wildlife on August 8, 2007 (USDI Fish and Wildlife Service 2007c; 72 FR 37345). Following delisting by the USFWS, the bald eagle was placed on the USFS R5 Sensitive Species List. Bald eagles continue to be protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act (BGEPA).

Critical habitat is not currently mapped or proposed for the bald eagle in the Sierra Nevada. Bald eagle habitat (nesting or winter) occurs throughout the Pacific Southwest Region, which includes both the

Sierra Nevada and Klamath Provinces. The Tahoe National Forest LRMP outlines management of bald eagle nesting and wintering habitats for target populations as specified in the species recovery plan. A Tahoe National Forest Bald Eagle Management Plan (April 2, 2004) has been submitted to the USFWS. Potential and known nesting and wintering habitat has not been mapped surrounding most reservoirs and lakes on the Forest, but most potential habitat has been surveyed. The SNFPA provided no new standards and guidelines for bald eagle management. Conservation recommendations from the Biological Opinion for the SNFPA (FWS 2001) are included as management recommendations within the Tahoe National Forest Bald Eagle Management Plan. The USFWS published National Bald Eagle Management Guidelines in May 2007.

Nesting territories are normally associated with lakes, reservoirs, rivers or large streams (Lehman 1979). Bald eagle nests are usually located in uneven-aged (multi-storied) stands with old growth components (Anthony et al. 1982). Most nests in California are located in predominantly coniferous stands. Factors such as relative tree height, diameter, species, and position on the surrounding topography, distance from water, and distance from disturbance also appear to influence nest site selection (Grubb 1976, Lehman et al. 1980, Anthony and Isaacs 1981).

Trees selected for nesting are characteristically one of the largest in the stand or at least codominant with the overstory. Nest trees usually provide an unobstructed view of the associated water body and are often prominently located on the topography. Live, mature trees with deformed tops are occasionally selected for nesting. Of nest trees identified in California, about 71 percent were ponderosa pine, 16 percent were sugar pine, and 5 percent were incense cedar. The remaining 8 percent were distributed among five other coniferous species. Eagle nests may be located in snags, but most nests are probably constructed when trees were alive (Anthony and Isaacs 1989). Nest tree characteristics in California have been defined by Lehman (1980) as being 41 to 46 inches in diameter at breast height and in excess of 100 feet tall.

In California, 73 percent of the nest sites were within 0.5 mile of a body of water, and 89 percent within 1 mile. No nests were known to be over 2 miles from water. Of 21 nests in Oregon, Anthony and Isaacs (1989) found 85% were within one mile of water. Bald eagles often construct several nests within a territory and alternate between them from year to year. Up to five alternative nests may be constructed within a single territory (U. S. Fish and Wildlife Service 1986).

Within Tahoe National Forest, twelve breeding territories have been identified within the forest boundary. Seven nest territories are on National Forest System land (2 at Stampede Reservoir, 1 each at Boca Reservoir, Bullards Bar Reservoir, Independence Lake, Prosser Reservoir and Deer Creek). Four nesting territories on private land occur within the forest boundary; one each at Fordyce Reservoir, Webber Lake, Spaulding Reservoir, and south of Milton Reservoir, and there is one nesting territory on State land at Donner Lake. Meadow Lake had fledglings in 2002 but no nest was located.

Tahoe National Forest lies within Zone 28 (Sierra-Nevada Mountains) of the Pacific Bald Eagle Recovery Area (USDI Fish and Wildlife Service 1986, p.138). Recovery goals identify a target of six territories on the forest, three territories at Bullards Bar Reservoir, and one territory each for Stampede, Boca, and Jackson Meadows. Considering the previously mentioned twelve territories within Tahoe National

Forest (assuming the Milton Reservoir territory substitutes for Jackson because of its close proximity), recovery goals for the numbers of territories have been met.

Potential risk factors to the bald eagle from resource management activities include modification or loss of habitat or habitat components (primarily large trees) and behavioral disturbance to nesting eagles from vegetation treatment, facilities maintenance, recreation, or other associated activities within occupied habitat, which could prevent or inhibit nesting or lead to nest failure (USDA Forest Service 2001).

No bald eagle nest territories are located within the Sagehen Project area. Within the wildlife analysis area, a bald eagle nest territory is located on the western boundary of Independence Lake on the Sierraville Ranger District, over 2 ½ air miles from the nearest project unit. A wintering bald eagle roost site occurs along the Little Truckee River nearly 1 mile from project units. Incidental bald eagle sightings are known from within the analysis area during late summer, fall, and winter months.

Direct and Indirect Effects: Bald eagles that may incidentally use the Sagehen basin for foraging or movement may be directly disturbed from project activities. These activities would be short in duration, but since breeding habitat for the bald eagle does not occur within the project area, this project will not directly or indirectly affect nesting bald eagles. Therefore, project effects under the action alternatives should not affect the distribution of breeding or winter roosting bald eagles or their habitats when they are most vulnerable to displacement or nest abandonment from ground disturbing activities.

Conclusion and Determination: Alternative 1 and 3 may affect individuals, but are not likely to result in a trend toward Federal listing or loss of viability for the bald eagle within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the bald eagle as discussed previously in this evaluation, and professional judgment. Incidental bald eagles that may be foraging or travelling through the Sagehen Project area may be disturbed from project activities, but nesting bald eagles will not be affected by implementing Alternatives 1 or 3 since no active bald eagle territories occur within close proximity to proposed treatment units.

CALIFORNIA SPOTTED OWL

Status: USFS R5 Sensitive

The California spotted owl is a management indicator species on all National Forests in the Sierra Nevada Bioregion, and is listed on the USFS R5 Sensitive Species List for Tahoe National Forest. There are three subspecies of spotted owls: the California spotted owl, the northern spotted owl, and the Mexican spotted owl. Both the northern and Mexican subspecies are listed as threatened by the USFWS. The three subspecies occupy fairly geographically distinct areas, with the California spotted owl in the southern Cascades generally south of the Pit River, throughout the Sierra Nevada mountains, the mountainous regions of southern California, and the central coast ranges at least as far north as Monterey County (Gutiérrez and Barrowclough 2005). The elevation of known nest sites ranges from about 1,000 feet to 7,700 feet, with about 86 percent occurring between 3,000 and 7,000 feet. The California spotted owl has been petitioned for listing as threatened or endangered, but upon status

review the USFWS has found it has not warranted listing, most recently on May 24, 2006 (USDI Fish and Wildlife Service 2003; 68 FR 7580, USDI Fish and Wildlife Service 2006; 71 FR 29886).

Risk factors for the California spotted owl include loss of habitat abundance, habitat fragmentation, reduction in habitat quality, climate change, the effects of wildfire, disturbance at breeding sites, the invasive barred owl, disease, and blood parasites (USDA Forest Service 2001a, Vol. 3, pp. 69-112, Ishak et al. 2008, USDA Forest Service 2009).

The California spotted owl has been on the USFS Region 5 Forester's Sensitive Species list since the late 1970s (Beck and Gould 1992). In 1981, Region 5 adopted a strategy for maintaining viability of the California spotted owl through a network of designated Spotted Owl Habitat Areas (SOHAs) to be managed to maintain suitable California spotted owl habitat, with 33 SOHAs in Tahoe National Forest (Beck and Gould 1992). In 1993, based on recommendations by the Technical Assessment Team to the Interagency Steering Committee for the California Spotted Owl Assessment, the "CASPO guidelines" were put in place for managing California spotted owl habitat. The CASPO guidelines were in place until January 2001 when the Record of Decision for the Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement was signed (SNFPA 2001 ROD; USDA Forest Service 2001). The SNFPA 2001 ROD outlined guidelines for management of SOHAs, Protected Activity Centers (PACs), Home Range Core Areas (HRCAs), old forest emphasis areas, and general forest that were designed to maintain important habitat elements for the California spotted owl. PACs were designated as 300 acres and HRCAs were designated as 1,000 acres (including the 300 acre PAC) of the best available habitat around spotted owl activity centers. The SNFPA 2001 ROD was replaced by the SNFPA 2004 ROD due in large part to the complexity of implementing the SNFPA 2001 ROD in meeting fuels reduction needs, and to provide more flexibility for managers to meet broader resource goals and objectives (USDA Forest Service 2004). Both SNFPA decisions (2001 and 2004) are conservation strategies for old forest and associated species designed to provide environmental conditions to maintain old forest associated species, most specifically the California spotted owl, well-distributed across Sierra Nevada national forests. The strategies seek to maintain canopy cover, big trees and stand structure known to be important to California spotted owls, while addressing the need to reduce the threat of catastrophic wildfires to owl habitat (USDA Forest Service 2004). The HFQLG pilot project is part of the SNFPA conservation strategy.

Tahoe National Forest includes one of the nine geographic areas of concern identified in the CASPO report (Beck and Gould 1992). This area of concern approximately incorporates the middle third of the forest, and was identified because the checkerboard pattern of public and private lands increases the uncertainty that owl habitat would be maintained across ownerships (Beck and Gould 1992). When combined with the natural habitat fragmentation of the higher elevations by rock outcrops and the resulting relatively low spotted owl density, landscape-scale habitat fragmentation could occur from east to west. This increases the risk to owl populations if the owl's status in the Sierra Nevada deteriorates (Beck and Gould 1992).

In February 2003, Tahoe National Forest refined existing and delineated new PACs and HRCAs according to direction in the SNFPA (USDA Forest Service 2001). This work is updated at least once a year to add

new, or revise boundaries, of PACs and HRCAs. Based on GIS analysis conducted in 2009, there are approximately 150,000 acres included within approximately 181 PAC/HRCAs in Tahoe National Forest. Surveys for the California spotted owl have been conducted in Tahoe National Forest since the late 1970s. Currently, surveys conducted in Tahoe National Forest follow the Pacific Southwest Region Protocol for Surveying for Spotted Owls in Proposed Management Activity Areas and Habitat Conservation Areas (USDA Forest Service, March 12, 1991, revised February 1993).

Spotted owl home range sizes are extremely variable across their range, and are suspected to be linked to availability of prey (Verner et al. 1992b, Zabel et al. 1992, Zabel et al. 1995, Bingham and Noon 1997). Bingham and Noon (1997) found that home range sizes of California spotted owls on Lassen National Forest (n = 4) averaged 6-8 times larger than estimates for northern spotted owls (n = 20) and noted that this is believed to reflect differences in habitat composition and prey availability rather than subspecific differences. California spotted owl home range is smallest in habitats at relatively low elevations that are dominated by hardwoods, intermediate in size in mixed-conifer forests, and largest in true fir forests (Zabel et al. 1992). At the time of the CASPO report in 1992, in the Sierran conifer forests a rough estimate of mean home range for California spotted owl pairs based on available information was 4,200 acres (Zabel et al. 1992). Call et al. (1992) found the medium summer home range in Tahoe National Forest to be 3,600 acres, though this was calculated based on data from only five owls. Bingham and Noon (1997) calculated the mean home range size for 4 individual owls on Lassen National Forest as 4,263 acres, ranging from 1,236 to 9,982 acres. In their study, core areas (polygons that included areas of the most intense use; mean 2,011 acres, range 734 to 4,161 acres) generally encompassed 20-21% of the home range and generally included 60-70% of breeding season activity (Bingham and Noon 1997). Recent research has assessed California spotted owl habitat at multiple scales. On the Lassen study area, Blakesley (2003) based her analysis on two scales, 500 acres and 2,011 acres, representing the nest area and core area. She calculated the nest area as the area encompassed by approximately ½ the minimum distance between nest sites of adjacent pairs, and based the core area on Bingham and Noon's (1997) estimated size of breeding season core areas on Lassen National Forest. On the Eldorado study area, Chatfield (2005) modeled habitat with circular plots centered on owl nest and/or roost locations of approximately 100, 300, and 1,170 acres, representing the nest stand, PAC, and territory scales, respectively. Seamans (2005), in analysis of owls on the Eldorado density study area, defined a territory as a circle with radius ½ the mean nearest neighbor distance of occupied territories, resulting in a circle encompassing 988 acres. Seamans (2005) found that this territory size (988 acres) encompassed >90% of all known roosts.

It is well-established that California spotted owls utilize various compositions of mixed conifer, ponderosa pine, red fir and montane hardwood forest types with high structural diversity, and dominated by medium (12-24") and large (>24") trees and with moderate to high levels of canopy cover (generally >40%) (Bias and Gutiérrez 1992, Call et al. 1992, Gutiérrez et al.1992, Verner et al. 1992b, Zabel et al. 1992, Moen and Gutiérrez 1997, Blakesley 2003, Blakesley et al. 2005, Chatfield 2005, Lee and Irwin 2005, Seamans 2005). Optimal habitat conditions likely involve mixtures of forest stands with differing compositions and densities (Bias and Gutiérrez 1992, LaHaye et al. 1997, Irwin et al. 2007).

Nesting habitat has been primarily characterized by dense canopy closure (generally >70% total canopy cover above 7 feet) dominated by medium (12-24" dbh) to large (>24") trees and multi-storied structure stands (Verner et al. 1992b, Moen and Gutiérrez 1997, North et al. 2000, Blakesley 2003, Blakesley et al. 2005). Nests can be found in side cavities of live and dead firs and pines, in the top of broken-topped trees and snags, in platform nests which naturally exist in branching structures or which were built by another species, or in mistletoe brooms (Gutiérrez et al. 1992, Blakesley et al. 2005). Blakesley et al. (2005) found the mean diameter of nest trees on the Lassen study area was 46" dbh, with over 90% of nests in >30" dbh trees. Large remnant trees (>30"), even if they occur at low density (<0.5/acre), appear important to serve as nest trees (Blakesley 2003, Blakesley et al. 2005). Testing against other habitat variables,
Foraging habitat includes mid- to late-seral forest with at least 40-50% canopy closure (Verner et al. 1992b). Irwin et al. (2007) found optimal foraging habitat was represented by moderately-dense forest with basal area from 152 to 240 ft^2/acre in Douglas-fir, white fir, and red fir, and greater basal area of large (>8" dbh) hardwoods. Daytime roosts are typically in denser forests with greater basal area and overstory canopy cover than for nocturnal roosts (Irwin et al. 2007).

Lee and Irwin (2005) examined the potential long-term effects to California spotted owl occupancy and reproduction by landscape-level reductions in canopy cover through various combinations of mechanical forest thinning and wildland fire through six decades. They modeled various long-term scenarios of no treatment, light thinning with prescribed fire, heavy mechanical thinning, mixed-lethal fire (6 foot flame lengths), and lethal fire within spotted owl territories. The light and heavy thinning prescriptions were modeled to leave the larger trees regardless of species. Three categories of spotted owl territories were examined over a projected six decade time period, representing territories with a higher proportion of sparse canopy cover (non-reproductive territories), territories with an intermediate mix of canopy cover classes, and territories with a larger proportion of dense canopy cover. Lee and Irwin (2005) state:

> "None of the simulated trajectories moved beyond the range of observed variation in the original data, suggesting that expected effects on owl reproduction would be essentially immeasurable. Our simulation results lend credence to the hypothesis that modest fuels treatments are compatible with territory-level canopy cover needs for spotted owl reproduction in the Sierra Nevada."

Lee and Irwin (2005) note that their analysis of fire effects was simplified when compared to the complex fire behavior characteristics of most landscapes, and that all potentially complex habitat elements important to spotted owls were not analyzed. They specify that the entire complex of factors affecting owls should be considered when designing and implementing thinning projects in order to minimize risk to spotted owls.

The invasive and more aggressive barred owl poses a potential threat to the California spotted owl in competition for food and nesting resources, possible displacement, hybridization with the spotted owl, and potentially increased spread of disease and blood parasites (Ishak et al. 2008, USDA Forest Service 2009). Beginning around the late 1800s, the barred owl expanded its range from the forests east of the

Great Plains to forests in the western United States, arriving in northern California around the late 1970s from Oregon, and in the Sierra Nevada in the 1980s where they have continued to increase in abundance though at a slower rate than their expansion in Washington and Oregon (Livezey 2009, USDA Forest Service 2009). The barred owl is more of a habitat generalist than the spotted owl, occupying a greater variety of habitats and having a wider range of prey than the spotted owl (Livezey 2007, Livezey et al. 2008). Spotted owls have been found to have higher prevalence of blood parasite infection than barred owls in the western United States, which may translate to an additional competitive advantage for the barred owl over northern and California spotted owls (Ishak et al. 2008). There is at least one known barred owl territory in Tahoe National Forest which has existed since the early 1980s.

Suitable spotted owl habitat within the Sagehen Basin has been surveyed to USFS Region 5 Spotted Owl protocol including historic visits since 1991. There is one California spotted owl territory (PAC NEV0059) located within the Basin. Table 3.10 below displays a summary of spotted owl detections and reproductive status from 1991 to present. A pair of adults was initially detected in 1991 and subsequent surveys indicate the PAC continues to be occupied as evidenced by recent surveys, but reproductive status has and continues to be inconclusive. It is not known whether or not these owls have been reproductively successful within the basin. The habitat within the Sagehen Basin is generally not considered quality habitat for spotted owls compared to habitat on the westside of the Tahoe NF where the majority of spotted owls occur and where larger more contiguous tracts of higher quality suitable habitat exists. Generally, the habitat in the Basin is largely unsuitable to spotted owls, lacking in older, larger trees and dense forest conditions preferred by spotted owls as described from spotted owl studies (Blakesley 2003, Blakesley et al. 2005, USDA Forest Service 2009). In addition, eastside habitat conditions are generally, more xeric comprised largely of eastside pine, Jeffrey pine, and lodgepole pine.

Table 3.10. Summary of Sagehen Basin Spotted Owl PAC (NEV0059) Reproductive Status

Year Surveyed	Territory and Reproductive Status
1991	Active: Pair reported
1996	Active: Agitated female response, reprod. status unknown
1997	Active: Adult response, reproductive status unknown
2003	Active: Reproductive status unknown
2004	Active: Pair detected, reproductive status unknown
2005	Active: Pair detected, reproductive status unknown
2006	Active: Female detected, reproductive status unknown
2009	Inactive

2010	Inactive
2011	Inactive
2012	Active: Adult detected, reproductive status unknown

Suitable Nesting and Foraging Habitat Description and Analysis Area

Suitable spotted owl habitat for analyzing the direct, indirect, and cumulative effects project alternatives was generated by modeling habitat using the current Tahoe NF vegetation map and Geospatial Interface tools for ArcGIS. Within the Sagehen Wildlife analysis area, there is a total of 29,467 acres of which 75% (22,236 ac) is on National Forest System lands (NFS) and 25% (7,230 ac) is in private ownership. Of the total NFS land in the analysis area, 2% is suitable spotted owl high quality nesting, roosting, and foraging habitat, 27% is suitable high and moderate quality foraging habitat, and 71% is not suitable based on the CWHR suitability criteria Table 3.12 below.

Table 3.12. Analysis Area Acres and Percentages of Suitable Spotted Owl Habitat by Ownership

Habitat Suitability	**Forest Service**			**Private**		
	Acres	% Habitat FS lands (22,236)	% FS Habitat in analysis area (29,467 ac)	Acres	% Habitat PVT lands (7,230 ac)	% PVT Habitat in analysis area (29,467 ac)
High Quality Nesting, Roosting, and Foraging (1,171 ac)	502	2	2	669	9	2
High and Moderate Quality Foraging (7,202 ac)	5871	27	20	1,331	18	5
Not Suitable (22,237 ac)	15,863	71	53	5,230	73	18
Total	**22,236**	**100**	**75**	**7,230**	**100**	**25**

Figure 3.2 depicts a map of suitable owl habitat within the Sagehen analysis area including proposed treatment units.

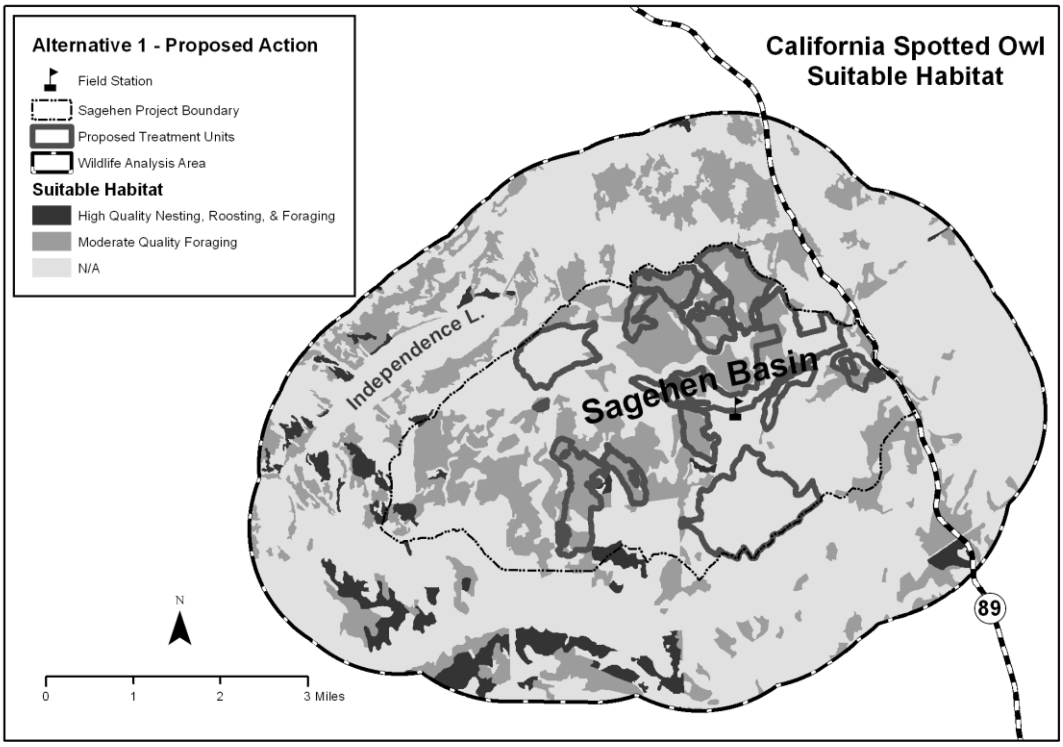


Figure 3.2. California Spotted Owl Suitable Habitat

Direct Effects – Project Disturbance

A California spotted owl territory (NEV0059) located near the central portion of the Sagehen Basin has been active since 1991. Recent surveys indicate this territory remains active. Proposed treatment units in Alternatives 1 and 3 are located >1/4 mile from known nest or roost sites, and therefore would not directly affect nesting spotted owls. In the event that a new nest or roost site is identified, a Limited Operating Period would be implemented during the breeding season (March 1 to September 30) to prevent any direct disturbance from project activities.

Indirect Effects - Habitat Quantity and Quality

The indirect effects of the project alternatives to spotted owl nesting and foraging habitat will be described at two spatial scales: 1) the PAC and HRCA and 2) across the proposed treatment units. The metrics or considerations for analyzing indirect effects are as follows:

- Changes to CWHR Type, Size Class, and Canopy Cover
- Snags and Downed Log Abundance
- Habitat Fragmentation and Structural Diversity
- Forest Resiliency

<u>Protected Activity Center (PAC) and Home Range Core Area (HRCA)</u>

Within the Sagehen Basin there is one spotted owl nesting territory PAC NEV0059. No treatments are proposed within the Protected Activity Center (PAC) under Alternatives 1, 2, 3, and therefore, there would be no indirect effects of habitat alteration within the core nesting area. Findings by Berigan et al. (2012) indicate that the U.S. Forest Service management strategy which relies on protecting spotted owl habitat (PACs) around owl territory centers is integral to the conservation of spotted owls in the Sierra Nevada because owls consistently use these areas over long time periods. Therefore, it can be reasonably concluded that retaining the best available habitat within the PAC (i.e. not reducing the quantity or quality of suitable habitat) continues to be a critical strategy for conserving key habitats used by owls for nesting and roosting.

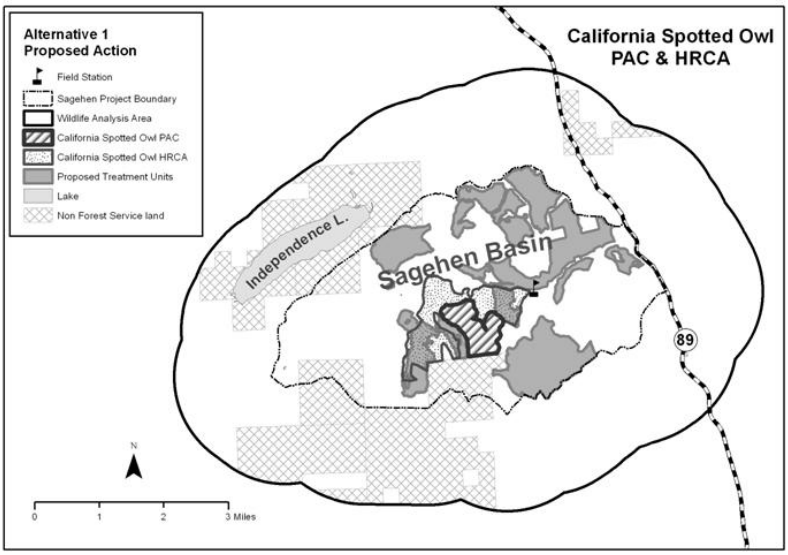


Figure 3.3. California Spotted Owl PAC and HRCA and Proposed Action Treatment Units

<u>Variable Thinning, Legacy Tree Treatment, Suppressed Cut and Fuels Treatments</u>

Proposed variable thinning, legacy tree treatment, and suppressed cut treatments, along with follow-up fuels treatments within the HRCA would result in residual forest conditions where existing suitable owl foraging habitat would remain suitable following treatments.

In general, hand thinning treatments (Unit 61) under Alternatives 1 and 3 would not result in any changes to CWHR types, as only small diameter trees would be removed. Fuels treatments would hand pile and burn materials removed through hand thinning. Following thinning, underburning would result in consuming some small diameter trees that are not removed by hand thinning including understory vegetation. Generally, underburning would result in approximately 30 percent of the unit affected, so not all the understory vegetation would be removed, and therefore a mosaic of habitat conditions would be present for spotted owl prey species, including small mammals, such as deer mice and flying squirrels.

Under Alternative 1, Units 156, 163, and 213 are proposed for a variety of treatments including Dense Cover Areas, Early Seral Openings, Variable Thinning, Legacy Tree Treatment, Suppressed Cut, and Decadent Feature Enhancement. Although, variable thinning, legacy tree treatments and suppressed cuts have different silvicultural objectives, changes to CWHR habitat types are not necessarily sensitive enough to detect differences from the various treatments. Therefore, variable thinning, suppressed cut, and legacy tree treatment will be considered together.

Alternative 3 proposes fuel reduction treatments using hand methods. Mechanized equipment would not be utilized under this alternative. Within the HRCA, only Unit 61 is proposed for treatment under Alternative 3. Alternative 3 proposes to hand thin 20 acres of suitable owl foraging habitat in the HRCA, compared to 234 acres of mechanical thinning treatments in Alternative 1. Alternative 3 does not change CWHR size or density classes, but would result in a 10% reduction in canopy cover. Compared to Alternative 1, Alternative 3 would have the least canopy cover reduction in spotted owl foraging habitat; however, forest resiliency and enhanced structural diversity would not be achieved on 234 acres within the HRCA, where stand replacing fires would remain a higher risk compared to Alternative 1.

Table 3.13. Acres of Changes to CWHR by Spotted Owl Nesting and Foraging Habitat within HRCA (NEV0059) from Variable Thinning, Legacy Tree Treatment, and/or Suppressed Cut

Alternative 1

Unit	Unit Acres	Emphasis Area	Emphasis Area Acres	Variable Thinning, Legacy Tree Treatment and/or Suppressed Cut	Nesting Habitat (CWHR 5M, 5D, 6)	Foraging Habitat (CWHR 4M, 4D)				Unit Average Canopy Cover	
					Nesting Habitat Acres	Foraging Habitat Acres	Current Tree Size and Canopy Cover	Post-Treatment Tree Size and Canopy Cover	Acres Change in Tree Size and Canopy Cover Class	Current	Post-Treatment
61	20	1	15	14.5	0	14.5	4D	4D	0	74	64
		2	5	5.3		5.3	4D	4D	0		
156	84	1	84	25.9	0	22.3	4D	4M	22.3	75	54
						3.6	4M	4M	0		
163	82	1	29	21.1	0	20.8	4D	4M	20.8	66	50
						0.3	4M	4M	0		
		5	49	37.6	0	27.4	4D	4M	27.4		
						10.2	4M	4M	0		
		7	4	2.8	0	2.8	4M	4M	0		
213	268	1	182	97.8	0	97.6	4D	4M	97.6	68	55
						0.2	4M	4M	0		
		2	11	9.5	0	1.4	5D	5M	1.4		
						8.1	4D	4M	8.1		
		4	21	7.4	0	7.4	4D	4M	7.4		
		5	18	5.9	0	5.9	4D	4M	5.9		
		6	25	6.4	0	6.4	4D	4M	6.4		
Totals	**454**		443	**234.4**	0	**234.4**			**197.3**		

Alternative 3

Unit	Unit Acres	Emphasis Area	Emphasis Area Acres	Variable Thinning, Legacy Tree Treatment and/or Suppressed Cut	Nesting Habitat (CWHR 5M, 5D, 6)	Foraging Habitat (CWHR 4M, 4D)				Unit Average Canopy Cover	
					Nesting Habitat Acres	Foraging Habitat Acres	Current Tree Size and Canopy Cover	Post-Treatment Tree Size and Canopy Cover	Acres Change in Tree Size and Canopy Cover Class	Current	Post-Treatment
61	20	1	15	14.5	0	14.5	4D	4D	0	74	64
		2	5	5.3		5.3	4D	4D	0		
Total	**20**			**19.8**	**0**	**19.8**					

Table 3.13 above displays the changes to spotted owl nesting and foraging habitat by CWHR size and canopy cover within the HRCA NEV0059.No suitable high and moderate quality nesting habitat (5M, 5D, 6) would be affected by proposed variable thinning, legacy tree treatment or suppressed cutting. There are approximately 234acres (33%) out the 714-acre HRCA (not including the 296-acre PAC) that are proposed for thinning treatments under Alternative 1 and would remain suitable for foraging post-treatment, but would be reduced in quality. A unit by unit summary of changes to suitable spotted owl foraging habitat from proposed treatments are described below. Suitable nesting habitat (CWHR 5M, 5D, 6) does not occur in any of the proposed treatments, and therefore would not be affected.

Unit 61 (Emphasis Areas 1, 2)

Twenty acres of suitable spotted owl foraging habitat in the HRCA proposed for variable thin and suppressed cut would remain CWHR 4D post-treatment under Alternatives 1 and 3. The average unit canopy cover would be reduced from 74% to 64%, where habitat suitability would remain unchanged. Habitat quality would be slightly reduced, but would not likely significantly affect spotted owl habitat suitability for foraging owls.

Unit 156 (Emphasis 1)

Within the HRCA, approximately 26 acres of suitable foraging habitat proposed for variable thin, legacy tree treatment, and suppressed cut. Twenty-two acres would change from CWHR 4D to 4M, where habitat quality would be reduced. However, habitat suitability would be unchanged following treatments. An additional 2 acres would remain CWHR 4M after treatment. The unit average canopy cover would change from 75% to 54% following treatments.

Unit 163 (Emphasis Areas 1, 5, 7)

In Unit 163, within the three emphasis areas, a total of 48 out 61 acres foraging habitat in the HRCA would change from a CWHR 4D to 4M following proposed treatments, resulting in reduced habitat quality. The remaining 13 acres of foraging habitat classified as CWHR 4M would remain 4M. The unit average canopy cover would change from 66% to 50% as a result of treatments.

Unit 213 (Emphasis Areas 1, 2, 4, 5, 6)

The majority of this large 268-acre unit falls within Emphasis Area 1 which is predominantly located on north facing slopes, but does include some ridges, and some higher elevation south facing slopes (above 6,725 feet). In the HRCA, 121 acres of suitable foraging habitat are proposed for variable thinning, legacy tree treatment or suppressed cutting treatments, with 98 acres in Emphasis Area 1 and the remaining spread across the other emphasis areas ranging from 1 to 8 acres. All 121 acres of suitable habitat would change from CWHR 4D to 4M. The unit average canopy cover would change from 68% to 55%, where foraging habitat quality within the HRCA would be reduced in the short-term. However, the existing foraging habitat within the HRCA would remain suitable for foraging following the treatments.

Dense Cover Areas (DCAs) and Early Seral Openings (ESOs) in Spotted Owl HRCA (NEV0059)

Units: 61, 156, 163, 213 (all emphasis areas)

As described in the proposed action, dense cover areas (DCAs) are small areas distributed within treatment units that provide continuous vertical and horizontal cover with a mixture of shrubs and trees along with large and small down wood, snags, and high stumps. DCAs would typically contain clumps of trees of various size classes as well as a variety of snag and down wood sizes. These DCAs, ranging in size from 0.25-1 acre, would contribute to/enhance within-stand horizontal and vertical structural diversity and provide important old forest and/or mid seral habitat elements within the HRCA.

ESOs would be comprised of dense young regenerating trees and/or shrubs to provide early successional habitat within larger stands managed for late successional or old forest habitat. ESOs, from 0.25-0.50 acre, would enhance within-stand age and species diversity. ESOs would be created by taking advantage of existing conditions, such as areas of sparse tree cover, thinner soils, or pockets of extensive tree mortality. Openings would be created by removing most or all of the existing trees and either planting or allowing natural shrub and/or tree regeneration to create an ESO of early successional habitat. Within ESOs (regeneration areas), prescribed fire would be applied to regenerate shrubs and create suitable areas for shade-intolerant tree species to regenerate.

For DCAs comprised of multiple sizes of trees, snags, and down wood, prescribed fire would be carefully applied to maintain key habitat elements, particularly snags and down wood. Underburning in DCAs comprised of multiple sizes of trees, snags, and down wood would likely result in some mortality of suppressed and subdominant trees. Burning prescriptions would be designed to ensure the overall structure of the DCA would remain intact.

Under Alternative 1, approximately 24 acres of DCAs within the HRCA would be designated for retention and would continue to provide areas of higher canopy, vertical and horizontal structure, down wood, snags, and high stumps in their existing condition. The 9 acres of ESOs scattered across 3 units (156, 163, 213) in the HRCA would result in removal of all existing trees and would eventually be planted or naturally regenerate over time. The CWHR vegetation class in ESOs would likely remain the same as the current existing vegetation following treatment because it is expected that they would eventually become naturally regenerated with existing surrounding tree species. However, the CWHR tree size and canopy classes would be changed to early seral openings following treatments, as all trees would be removed. It is expected that the ESOs would eventually become forested and not result in long-term type conversion.

Additionally, the ESOs would not alter or change the habitat suitability for spotted owls across the units or would not result in habitat fragmentation at the landscape level. These DCAs and ESOs combined with variable thinning, legacy tree treatments, suppressed thinning, and associated fuels treatments would result in a more diverse and resilient landscape within and surrounding the 1,010-acre HRCA (296-ac PAC plus surrounding 714-ac HRCA), although localized effects from the

treatments would vary depending upon the size of the openings and site-specific conditions. Generally, the creation of early seral openings would be expected to result in increased shrubs, which would benefit prey species diversity. The overall effects to the HRCA would be minimal, since the openings are small and scattered.

Alternative 1 would provide more structural diversity within the HRCA from DCAs and ESOs scattered throughout across 486 acres within Units 61, 156, 163, and 213 compared to both Alternatives 2 and 3. Under Alternative 3, the non-commercial funding alternative, only Unit 61 is proposed for treatment, where a total of 2.5 acres of DCAs are proposed within the 20-acre unit. There would be no ESA treatments within the HRCA for Alternative 3. For Alternative 2 there would be no implementation of DCAs or ESOs: the HRCA would remain in the existing condition and would not provide for increased vegetation structural and age class diversity across the 486 acres.

Indirect Effects to Suitable Spotted Owl Habitat

Suitable spotted owl foraging and nesting habitat was assessed for their potential effects from proposed activities for each of the action alternatives. No suitable nesting habitat (CWHR 5M, 5D, 6) occurs within proposed treatment units for Alternatives 1 and 3, and therefore would not be affected by thinning or fuels treatments. Under Alternative 1, 1,280 suitable spotted owl foraging habitat is proposed for thinning out of the total 2,485 acres that would be treated. Thinning and fuels treatments, including variable thinning, legacy tree treatments, and suppressed cutting would result in 798 acres that would be reduced in habitat quality where CWHR 4D types would change to CWHR 4M types. On all 1,280 of suitable foraging habitat, canopy cover would be reduced, but foraging habitat would remain suitable following treatments. Current unit average canopy cover ranges from 51% to 80% and post-treatment average canopy cover would range from 41% to 71%.

Under Alternative 3, 112 acres of suitable foraging habitat proposed for treatments would result in lowered canopy cover in the short term, where 19 acres would change in CWHR type 4D to 4M. However, under Alternative 3, the opportunity to increase and enhance forest resiliency and structure diversity would not be achieved on 1,168 acres that are proposed for treatments under Alternative 1. Similar to Alternative 1, nesting habitat would not be affected by Alternative 3 activities. The average unit canopy cover for units proposed for treatment under Alternative 3 currently ranges from 51% to 76%. Average canopy cover for the units following treatments would range from 41% to 64%.

Under Alternative 2, no action, 1,280 acres suitable foraging habitat would not be treated and therefore, canopy cover would not change or be reduced in quality. However, forest resiliency, forest structural diversity, and reduced fuels hazard would not be realized under the no action alternative. In the long-term, spotted owl foraging habitat, including those within and surrounding the PAC, would remain at a higher risk of potentially severe wildfire effects under the no action alternative.

For 1,280 acres of suitable foraging habitat within treatment units, all 1,280 would have reduced foraging habitat quality, as stated above. For Alternative 1, 76 acres would remain unchanged in the

CWHR 5D/4D type, 40 acres would change from CWHR 4D to 4M, 16 acres would change from 4D to 4P, 383 acres of CWHR 4M types would remain unchanged, and 32 acres would change from CWHR 4M to 4P types. Although Emphasis Area 6 within Unit 33 would reduce canopy cover to 38% post-treatment, the average canopy across the unit would result in a post-treatment canopy cover of 44%, and would therefore meet Forest Plan standards and guidelines for mechanical thinning. Treatments would result in increased structural diversity and forest resiliency through reduced hazard fuels while maintaining large trees and moderate canopy cover required for nesting.

For Alternative 3, 112 acres of suitable foraging habitat proposed for treatments would result in 83 acres that would remain as CWHR 4D, 10 acres would stay as CWHR 4M, and 19 acres would change from CWHR 4D to 4M following treatments, where habitat quality would be reduced. The quantity of suitability foraging habitat would be unchanged post-treatment.

Dense Cover Areas (DCAs) and Early Seral Openings (ESOs) in Suitable Spotted Owl Habitat

DCA's are areas that are delineated within treatment areas that will remain intact and provide high to moderate quality spotted owl foraging habitat which typically provide areas of higher canopy cover and larger trees compared to the surrounding areas. Alternative 1 proposes to delineate a total of 81 acres of DCAs, of which 12 acres are not suitable and 69 acres are suitable for foraging. Suitable nesting habitat is very limited within the Sagehen Basin and additionally, neglible suitable nesting habitat lies within proposed treatment units. Suitable nesting habitat is not affected by any ESO treatments. Alternative 1 proposes to create a total of 54 acres of ESOs, of which 8 acres are not suitable and 46 acres are suitable spotted owl foraging habitat.

Under Alternative 3 DCAs would only be designated and created within the 1,132 acres fuels treatment units (46, 47, 61, 76, 91, 98, 99, 100, and 282) of which only 112 acres (10%) are suitable foraging habitat for spotted owls. The DCAs would retain patches of the large trees available through the hand thinning units under Alternative 3, and would contribute to increased structural diversity across 1,132 acres compared to the 2,621 acres in Alternative 1 where both DCAs and ESOs would be implemented. Alternative 2 would have the least impacts to spotted owl habitat since ESOs would not be created where all the trees would be harvested. However, Alternative 2 would provide no change in forest structure and therefore the opportunity to increase forest structural diversity across the landscape would not be achieved.

Snags and Down Logs

Snags and down logs were analyzed in the section *Effects Common to All Wildlife*. Generally, Alternative 1 would maintain all existing snags >15 inch dbh, except for those needing to be removed for equipment operability or those that pose a risk public safety. The Forest Vegetation Simulator model predicted that Alternative 1 would result in lower snag abundance compared to Alternatives 2 and 3 within 30 and 50 years after treatment. Generally, Alternative 2 would result in the most snags compared to Alternatives 1 and 3, 30 and 50 years post-treatment. In all cases, the snag densities projected at 30 and 50 years post-treatment would retain snag densities per Forest Plan standards and guidelines throughout the Sagehen Basin under all the alternatives. As no

treatments are proposed within the PAC, all snags and down logs would be retained within the core area that would be needed for roosting and nesting.

Conclusion and Determination

THE SNFPA (2004) is a "Conservation strategy for old forest and associated species…(designed) to provide environmental conditions that are likely to maintain viable populations of old forest associated species, most specifically the California spotted owl, well-distributed across Sierra Nevada national forests. The strategy seeks to maintain existing suitable California spotted owl habitat to stabilize current population declines" (SNFPA ROD Appendix A page 1). The proposed Sagehen Project would implement the spotted owl SNFPA S&Gs by retaining suitable habitat through the retention of large trees, canopy cover >40%, and protect and create snags and down logs.

Habitat modeling has been used to project the effects of forest treatments on spotted owls and their habitat. Simulation modeling suggests that landscape-scale fuels treatments on a small proportion of the landscape can minimize effects to owl habitat and reduce risk of habitat loss to wildfire (Ager et al. 2007, Lehmkuhl et al. 2007 in Keane 2013). Some treatments may also reduce fire risk within core areas with minimal effects on owl reproduction (Lee and Irwin 2005). Habitat modeling indicates that the reduction of wildfire risk in the long-term may benefit spotted owls while having short-term effects on spotted owl habitat (Roloff et al. 2012 in Keane 2013). Results from modeling also suggests that fuels treatments can be effectively used to reduce wildfire risk and support restoration efforts while providing spotted owl habitat at home range and landscape scales. Hence, it would follow that while short-term impacts to spotted owl and their habitat from modifying 1,280 acres (Alternative 1) and/or 112 acres (Alternative 3) are expected, spotted owls within the Sagehen Basin would likely be benefited in the long-term by the reduction of high severity wildfire risk. The actual response of spotted owls to these types of treatments is uncertain, and therefore monitoring or studies to better understand spotted owl response to these types of treatments can better inform how owls respond to these types of treatments.

Additionally, the Sagehen Project uses concepts from GTR-220 and GTR-237 which strive to promote long-term ecosystem restoration, forest resiliency, and fuels reduction while using innovative vegetation treatments that enhances and retains suitable spotted owl habitat at the PAC and HRCA scale and within suitable habitat across the analysis area. The Sagehen Project, as proposed, would:

- Maintain suitable nesting, roosting, and nesting habitat within the PAC and HRCA and within suitable nesting and foraging habitat across the 29,467-acre analysis area. No treatments within the PAC are proposed for any of the action alternatives.

- Retain high and moderate quality nesting and roosting habitat dominated by large trees, moderate to high canopy cover, abundance of snags and downed logs , and therefore promote spotted owl occupancy and reproductive success, given the limited amount of high quality spotted owl habitat within the Basin.

- Maintain and create habitat for spotted owl for prey species, particularly, Northern flying squirrels, deer mice, pocket gophers, and other small mammals through various treatments, including dense Cover Areas , early seral openings, snag creation, and retention of shrubs.

- Promote forest resiliency and patch-scale heterogeneity to meet fuels and ecological restoration objectives while providing for spotted owl habitat

- Forest management and fuels reduction strategies uses slope, topographic position and aspect that would result under a natural disturbance regime may outweigh the short-term impacts of spotted owl habitat alteration

Implementation of Alternatives1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the California spotted owl as discussed previously in this evaluation, and professional judgment.

GREAT GRAY OWL

Status: USFS R5 Sensitive

The great gray owl is listed on the USFS R5 Sensitive Species List for Tahoe National Forest. The distribution of the great gray owl is circumpolar, with the Sierra Nevada encompassing the most southern extent of the species (Beck and Winter 2000). The core range of the great gray owl in California is centered on the greater Yosemite National Park area (Winter 1986, Greene 1995, Beck and Winter 2000, Sears 2006). There are records of great gray owls as far south as Tulare County, and to the north from the Modoc, Lassen, Plumas, Tahoe, and Eldorado National Forests, and from Del Norte, Humboldt, Shasta, and Siskiyou Counties (Beck and Winter 2000).

Current knowledge on great gray owl distribution and habitat requirements is somewhat limited, in part because research and surveys are difficult due to the wary and elusive behavior of the species (Sears 2006, Rognan 2007). There is a possibility that they will be found occupying additional locations where there is suitable habitat. Winter (1986) estimated the population in the greater Yosemite area at 73 birds in 1984, and Greene (1995) estimated over 100 birds (of all age classes) in the same area. Sears (2006) estimated 123 individuals throughout the Sierra Nevada based upon surveys to the northern and southern extent of their expected distribution and accounting for the previous estimates for the Yosemite area.

In the Sierra Nevada, great gray owls have been found to require two particular habitat components; a meadow system with a sufficient prey base, and adjoining forest with adequate cover and nesting structures (Winter 1980, Winter 1986, Greene 1995, van Riper and van Wagtendonk 2006). Meadows appear to be the most important foraging habitat for great gray owls, where approximately 93% of their prey is taken (Winter 1981). Data from the greater Yosemite area suggests that to support persistent occupancy and reproduction, meadows need to be at least 25 acres, but meadows as small as 10 acres may support infrequent breeding (Winter 1986, Beck and Winter 2000). Using radio telemetry, van Riper and van Wagtendonk (2006) found that over 60% of

all great gray owl locations were within 100 m (328 ft.) of a meadow; 80% of locations were within 200 m (656 ft) of a meadow. In their radio telemetry study, only twice did van Riper and van Wagtendonk (2006) locate great gray owls at distances greater than 1000 m (0.62 mile) from a meadow.

In the Sierra Nevada, great gray owl breeding activity is generally found in mixed coniferous forest from 2,500 to 8,000 feet elevation where such forests occur in combination with meadows or other vegetated openings (Greene 1995, Beck and Winter 2000). In their study in Yosemite National Park, van Riper and van Wagtendonk (2006) found that home ranges were located adjacent to meadows in red fir and Sierra mixed conifer most frequently, and home range boundaries followed meadow and drainage topography. They found that most females nested where red fir was the most common habitat type, and some nested in habitat dominated by lodgepole pine (van Riper and van Wagtendonk 2006). Habitat types used by breeding females included Sierra mixed conifer, montane riparian, and montane chapparal types (van Riper and van Wagtendonk 2006). Nesting usually occurs within 840 feet (averaging 500 feet) of the forest edge and adjacent open foraging habitat (Beck and Winter 2000). Greene (1995) found that nest sites had greater canopy closure (mean 84%) and were more likely located on northern aspects than expected by chance.

As with most owls, great gray owls do not build their nests (Bull and Henjum 1990, Greene 1995). In contrast to northeastern Oregon and elsewhere where platforms such as old hawk nests and mistletoe infected limbs are the predominant nest substrate (Bull and Henjum 1990), most nests in the Sierra Nevada have generally been found at the top of large broken top fir snags; fir snags tend to break at right angles and form a suitable nest substrate (Winter 1986, Greene 1995). Greene (1995) found that the next most preferred species for nesting was black oak, found at the lower elevations. Greene (1995) found that nest trees in Stanislaus National Forest averaged 32” dbh and 32 ft tall, while those in Yosemite National Park averaged 44” dbh and 45 ft tall. Greene (1995) suggests that a site may be occupied as long as there is at least one suitable large broken top snag for nesting, finding no correlation with occupied reproductive habitat and number of snags. In Stanislaus National Forest, numerous artificial nest structures which simulate broken topped snags have been created by topping large trees and hollowing out a nest bowl, and many have been used for nesting (Greene 1995).

In the Yosemite area, males begin establishing nesting territories in March to early April (Beck 1985). After 30 to 36 days of incubation, eggs hatch from mid May to mid June. Young begin to fledge in early June to early July, but will remain around the nest through August. However, great gray owls will breed earlier at higher elevations (approximately 2 weeks earlier for every 1,000 foot increase in elevation).

In Yosemite National Park, van Riper and van Wagtendonk (2006) found breeding season home ranges (95% adaptive kernel) averaged 152 acres for females and 49 acres for males. Breeding adults were found to utilize specific activity centers within the home range, with radio telemetry locations densely packed in localized areas; the activity centers averaged 43 acres (based on the 75% adaptive kernel home range). Activity centers were based around nests or roost sites but also

included nearby foraging areas, and were frequently associated with outer meadow boundaries (van Riper and van Wagtendonk 2006). While much larger than breeding season home ranges, non-breeding season home ranges were also centered on wet meadows (van Riper and van Wagtendonk 2006). During the non-breeding season, home ranges averaged 6,072 acres for females and 5,221 acres for males (van Riper and van Wagtendonk 2006). Prey of great gray owls is primarily pocket gophers and voles (Winter 1986, Reid 1989, Bull et al. 1989). If prey numbers are low in any given year, great gray owls may occupy a site but may not nest possibly due to the lack of ability to feed young (Bull and Henjum 1990).

In Tahoe National Forest, there have been few recorded great gray owl sightings, and nesting has only recently been confirmed in one location on or near private land. Possible sighting and/or detection locations include Perazzo Meadows (May 2004), along Pliocene Ridge Road (occasional sightings since 2003 with confirmed nesting in the area in 2009), three miles north of Nevada City (an adult located in January 1996 and January 1997), Donner Ranch Ski Area (pair observed in November 1994), near Spencer Lakes at the northern border of Tahoe National Forest (detection in July 1990), south of Lincoln Creek Campground (an individual in July 1987), and near Sattley (pair in January 1985). Surveys conducted by the Forest Service in Tahoe National Forest follow the currently accepted Region 5 protocol (Survey Protocol for the Great Gray Owl in the Sierra Nevada of California (Beck and Winter 2000).

Incidental sightings of great gray owls have been reported near the Sagehen Field Station (pers. comm. Jeff Brown). In the spring of 2012, a pair of great gray owls were located by The Nature Conservancy personnel near Independence Lake on land owned by the Nature Conservancy during surveys conducted for the proposed Independence Lake Fuels Reduction Project. The owls were not detected on subsequent follow-up surveys in attempts to locate nesting. An interagency group including, the Nature Conservancy, Forest Service, and CDFW inspected the area where the owls were found and concluded that the area did not conform to what typically would have been considered high quality nesting habitat. Instead the meadow where the owls were located had low growing herbaceous vegetation more typical of dry meadows rather than the wet meadows with dense and tall sedges and grasses. It is suspected that the great gray owls may have been using the area for foraging. Great gray owls are known to have large home ranges (5,000 to 7,000 acres), so it is difficult to know exactly where their nest territory is located, if they are breeding in the vicinity. However, the Independence Creek sightings would be well within the home range of the suspected great gray owl detections at Perazzo Meadows, approximately 5 miles to the northwest. Habitat at Perazzo Meadows is of exceptional high quality for nesting, although thorough survey efforts have been unsuccessful at detecting nesting activities. Confirmed nesting by great gray owls on the eastside of the Tahoe NF has not been established. The Independence Lake detections are located to the north of the Sagehen Project boundary on the Sierraville RD. Great gray owl surveys were conducted within suitable habitat using the R5 Great Gray Owl Protocol during 2005 and 2006. No detections of great gray owls were found. Within the Sagehen Basin, suitable great gray owl habitat is located in mature forests surrounding stringer meadows along Sagehen Creek near the Sagehen Field Station and a larger broader meadow/fen system near Sagehen Campground.

Direct and Indirect Effects

Direct Effects: Great gray owls that may use the Sagehen Project area (potentially for foraging) have the potential to be disturbed or temporarily be displaced by project activities. Project activities would be short-term in duration and would likely be spread across several years, so that, direct effects from disturbance would likely be limited in space and time. Alternative 1 would treat the most acres and therefore would likely pose the greatest risk of disturbance to great gray owls using the area. Alternative 2, no action, would not directly disturb great gray owls.

Indirect Effects: For both Alternatives 1 and 3, treatment within units 98 and 100, located adjacent to suitable meadow habitat, would modify suitable nesting habitat within 300 feet of the meadows. Thinning would reduce canopy cover, but would retain a minimum of 40% canopy cover within treatment units. All existing snags would be retained. Within Unit 100, decadent feature enhancement is proposed which would benefit great gray owls by creating snags that could be used for nesting in the near term. The lack of suitable nesting structures is a limiting factor for great gray owls. Proposed treatments under the action alternatives would provide structural diversity and enhance prey species habitats, while enhancing forest resiliency.

Conclusion and Determination

Great gray owls have not been found to nest within the Sagehen Basin, and therefore, the proposed action alternatives would not affect breeding individuals, or modify suitable breeding habitat. Implementation of Alternatives 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the great gray owl within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the great gray owl as discussed previously in this evaluation, and professional judgment.

NORTHERN GOSHAWK

Status: USFS R5 Sensitive

The northern goshawk (*Accipiter gentilis)* is listed on the USFS R5 Sensitive Species List for the Tahoe National Forest. In 1997 the northern goshawk was petitioned for listing as threatened or endangered (west of the 100th meridian), but upon status review the USFWS found it did not warrant listing (USFWS 1998; 63 FR 35183). Standards and guidelines for northern goshawk management are prescribed by the Tahoe National Forest LRMP, as amended. Current guidelines include delineation of protected activity centers (PACs) surrounding all known and newly discovered breeding territories detected on National Forest System lands. Northern goshawk PACs are designated based upon the latest documented nest site and location(s) of alternate nests. If the actual nest site is not located, the PAC is designated based on the location of territorial adult birds or recently fledged juvenile goshawks during the fledgling dependency period (USDA Forest Service 2004).

Northern goshawk PACs are delineated to: (1) include known and suspected nest stands and (2) encompass the best available 200 acres of forested habitat in the largest contiguous patches possible, based on aerial photography. Where suitable nesting habitat occurs in small patches, PACs are defined as multiple blocks in the largest best available patches within 0.5 miles of one another. Best available forested stands for PACs have the following characteristics: (1) trees in the dominant and co-dominant crown classes average 24 inches dbh or greater; (2) in westside conifer and eastside mixed conifer forest types, stands have at least 70 percent tree canopy cover; and (3) in eastside pine forest types, stands have at least 60 percent tree canopy cover. PACs are maintained regardless of northern goshawk occupancy status. PACs may be removed from the network after a stand-replacing event if the habitat has been rendered unsuitable as a northern goshawk PAC and there are no opportunities for re-mapping the PAC in proximity to the affected PAC.

As prescribed by the Tahoe National Forest LRMP, as amended, surveys are conducted in compliance with the Pacific Southwest Region's survey protocols during the planning process when vegetation treatments are likely to reduce habitat quality are proposed in suitable northern goshawk nesting habitat that is not within an existing California spotted owl or northern goshawk PAC. Suitable northern goshawk nesting habitat is defined based on the survey protocol. Surveys conducted in the Tahoe National Forest follow the Survey Methodology for Northern Goshawks in the Pacific Southwest Region, U. S. Forest Service (USDA Forest Service 2000).

In 1999, prior to PAC-delineation guidelines set forth in the 2001 and 2004 SNFPA, 64 Goshawk Management Areas had been identified in Tahoe National Forest based on known nest sites, territorial adults, and habitat suitability. In June 2003, the Tahoe National Forest reviewed existing Goshawk Management Area boundaries to ensure that they met the intent of the SNFPA 2001 direction for goshawk PACs. By June 2003 PAC delineation had been completed in Tahoe National Forest in accordance with SNFPA direction. At that time there were 71 northern goshawk PACs encompassing approximately 15,500 acres. Since then, additional PACs have been delineated based on new information, and as of 2012 there are 127 goshawk PACs in Tahoe National Forest encompassing 27,280 acres.

The Northern Goshawk Scientific Committee was established in 1990 to develop a credible management strategy to conserve the goshawk in the southwestern United States. Reynolds et al. (1992) recommendations included that goshawk nesting home ranges should exist as an interspersed mosaic of various structural stages in certain proportions, and that on every acre within home ranges there should remain a few large trees in clumps that live out their lives and eventually become snags, then logs that decompose. Their recommendations focused on three components of a goshawk's nesting home range, amounting to about 6,000 acres: nest area (approximately 30 acres), post fledging-family area (PFA; approximately 420 acres), and foraging area (approximately 5,400 acres; Reynolds et al. 1992). The nest area may include more than one nest, is typically located on a northerly aspect in a drainage or canyon, and is often near a stream (Reynolds et al. 1992). Nest areas contain one or more stands of large, old trees with a dense canopy cover (Reynolds et al. 1992).

Forest types associated with goshawk nest areas vary geographically (USFWS 1998, Kennedy 2003). In the Sierra Nevada goshawks breed from the mixed conifer forests at low elevations up to and including high elevation lodgepole pine forests and eastside ponderosa pine habitats. Goshawks winter from the lodgepole pine forest down slope to blue oak savannah (Verner and Boss 1980). In the Tahoe National Forest, goshawks are year-round residents. Nests are found in all of the vegetation types listed above, as well as in aspen stands (Tahoe 1999). Andersen et al. (2005), in review of existing research on goshawks including their nesting habitat and typical high canopy closure preferences, noted that high canopy closure in relation to the range of available canopy closure may be more important for goshawk nesting than absolute canopy closure, at least above some minimum threshold.

Many studies have shown that goshawks select more mature forest for nesting, with higher canopy cover and larger trees as compared to surrounding forest (e.g. Hayward and Escano 1989, Squires and Rugiero 1996, Daw and DeStefano 2001). Hypotheses for why goshawks select forest with larger trees and higher canopy cover include: 1) increased protection from predators, 2) increased food availability, 3) reduced exposure to cold temperatures and precipitation during the energetically stressful pre-egg laying period, 4) reduced exposure to high temperatures during the nestling period, 5) reduced competition with raptor species that nest in more open habitats, or 6) increased mobility because of reduced understory vegetation in mature stands (Andersen et al. 2005). Older age coniferous, mixed, and deciduous forest habitats provides large trees for nesting, a closed canopy for protection and thermal cover, and open spaces allowing maneuverability below the canopy (Fowler 1988). Analysis of vegetative data collected at 39 nest sites in the Tahoe National Forest and the Lake Tahoe Basin Management Unit indicates that goshawk nest stands in the Tahoe National Forest have a mean canopy closure of 70 percent, 32 large trees per acre (24-49 inch dbh), large amounts of dead and down logs, and slopes less than 15 percent.

Recommendations in the Southwest Region suggest managing 5,400 acres of foraging habitat per territory (Reynolds et al. 1992). Conclusions from studies in the Sierra Nevada support similar habitat requirements (Hargis et al 1994, Keane and Morrison 1994). Important components of foraging habitat include snags (min. 3/ac. >18" dbh) and logs (min. 5/ac. >12" dbh and > 8' long) for prey base populations (USDA 1991). Management requirements for the California spotted owl are thought to provide adequate quantities of snags and down logs to support goshawk prey species in foraging habitat (Tahoe 1999). Beier and Drennan (1997) found that goshawks selected foraging sites that had higher canopy closure, greater tree density, and greater density of trees greater than 16 inches in diameter. They recommend managing stands for canopy closure values above the prescribed minimum 40%. Primary prey species include small mammals and birds (Verner and Boss 1980, Fowler 1988).

Goshawk nesting activities are initiated in February. Nest construction, egg laying and incubation occur through May and early June. Young birds hatch and begin fledging in late June and early July, and are independent by mid-September.

Potential risk factors to goshawks include effects of vegetation management and wildfire on the amount, distribution, and quality of habitat (USDA Forest Service Pacific Southwest Region 2001a). In the Lake Tahoe Basin Management Unit, Morrison et al. (2011) found that human activity was twice as high within infrequently as compared to frequently occupied goshawk territories, and there was a greater extent of all types of roads and trails within the infrequently occupied territories. While it is not statistically significant, Grubb et al. (1998) noted no discernible change in behavior to logging truck noise as they passed at 500 meters from two active goshawk nests.

Suitable goshawk habitat within the Sagehen Basin has been surveyed to USFS Region 5 Northern Goshawk protocol including historic visits since 1992. There are five Northern goshawk territories located within the Basin. Table 3.14 below displays a summary of goshawk detections and reproductive status from 1992 to present for each PAC. Surveys indicate the five goshawk PACs continue to be occupied as evidenced by reproduction or detection of adults and/or young in recent years. In 2010, the NE Sagehen PAC was discovered while planning for the Sagehen Project was underway.

Table 3.14. Reproductive Status of Northern Goshawk Territories in the Sagehen Basin

PAC Name (Territory ID)	**Year Surveyed**	**Territory and Reproductive Status**
Lower Sagehen (D57T01)	2002	Active: 2 young
	2003	Active: reprod. Status unknown, wail and alarm calls heard
	2005	Active: female and begging calls heard
	2006	Inactive
	2009	Active: 2 young
	2010	Unknown Accipiters detected
	2011	Inactive
	2012	Active: fledgling detected
Upper Sagehen (D57T06)	1992	Active: Nest established, 3 fledglings
	1993, 1994, 1995	Inactive
	2006	Active: pair detected, nest fell down with possible nestling in nest

	2009	Active: adult + 2 nestlings
	2010	Active: nest established with at least 1 nestling
	2011	Unknown: juvenile detected outside of PAC
BGB (D57T21)	2004	Active: Pair detected, reproduction evident by white wash and feathers under nest
	2005	Active: 2004 nest not used; goshawk heard east of 2004 nest site
	2006	Active: reprod. status unknown, adult detected
	2009	Active: pair detected, nest not found
	2010	Inactive
	2011	Inactive
	2012	Active: 1 juvenile detected
NE SAGEHEN (D57T23)	2011	Active, New nest found, 1 fledgling
	2012	Active, original nest in disrepair, food begging call heard, indicating potential reproduction
Switchback (D57T22)	2004	Active: female and 2 nests found
	2005	Active: adult response
	2006	Active: pair
	2009	Active: adult + 1 fledgling
	2010	Active: adult + 2 fledglings
	2011	Active: 2 fledglings
	2012	Active: 2 nestlings

Suitable Goshawk Nesting and Foraging Habitat Description and Analysis Area

Suitable goshawk habitat for analyzing the direct, indirect, and cumulative effects project alternatives was generated by modeling habitat using the current Tahoe NF vegetation map and Geospatial Interface tools for ArcGIS. The existing vegetation maps are classified using the CWHR classification system. Suitable goshawk habitat for this project used the goshawk habitat suitability ratings from the CWHR Classification System. Within the Sagehen Wildlife analysis area, there is a total of 29,467 acres of which 75% (22,237 ac) is on National Forest System lands (NFS) and 25%

(7,230 ac) is in private ownership. Of the total National Forest System lands in the analysis area, 31% is suitable high quality nesting, roosting, and foraging goshawk habitat; 16% is suitable moderate quality nesting habitat; 37% is moderate and high quality foraging habitat; and 16% is not suitable, based on the CWHR suitability criteria.

Figures 3.4 and 3.5 depict maps of Northern goshawk suitable nesting, roosting, and foraging habitat including proposed treatments for the proposed action.

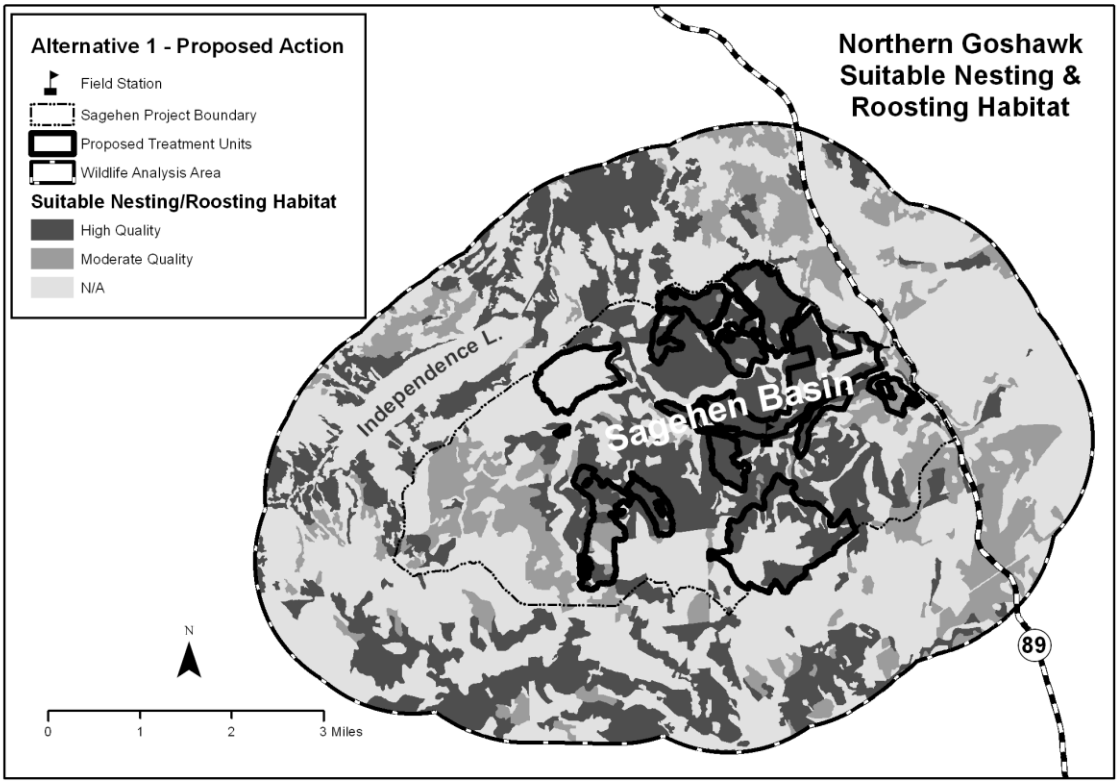


Figure 3.4. Suitable Goshawk Nesting and Roosting Habitat and Proposed Action Treatment Units

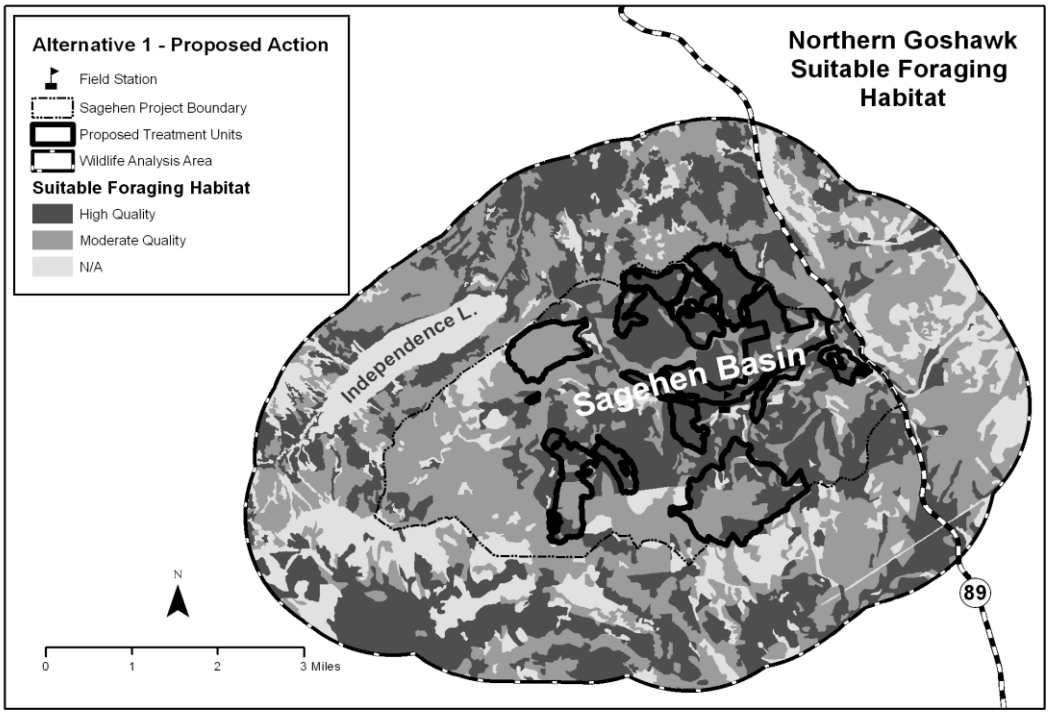


Figure 3.5. Suitable Goshawk Foraging Habitat and Proposed Action Treatment Units

Direct and Indirect Effects

Assumptions used for the analysis:

- Adult goshawk survivorship is positively correlated to the amount of mature forests (mid to late-successional forests)
- Goshawk owl territory occupancy is positively related to the amount of mature forest within the 200-acre Protected Activity Center
- High quality nesting and roosting habitat dominated by large trees, moderate to high canopy cover, abundance of snags and downed logs is related to goshawk occupancy and reproductive success
- Goshawk foraging habitat encompasses a broader range of vegetation conditions compared to nesting and roosting habitat, and is likely related to the availability and abundance of prey species, such as birds, jack rabbits, ground squirrels, deer mice, pocket gophers, and other small mammals
- Forest management aimed at promoting forest resiliency and patch-scale heterogeneity can meet fuels and ecological restoration objectives and provide for goshawk habitat (North et al. 2009, North et al. 2012)
- Forest management and fuels reduction strategies using slope, topographic position and aspect that would result under a natural disturbance regime may benefit goshawk by reducing the risk of stand-replacement wildfires, although short-term impacts to habitat would be expected

Direct Effects – Project Disturbance

Five Northern goshawk nest territories are located within the Sagehen Basin. Project-level noise and disturbance from treatment activities have the potential to disturb and disrupt nesting goshawk within the project area. In order to minimize direct project effects, a limited operating period from February 15 to September 15 for Units 33, 34, 35, 36, 38, 39, and 163. This LOP may be modified by the wildlife biologist if surveys determine nesting will not be affected within ¼ mile of the proposed activities.

Indirect Effects - Habitat Quantity and Quality

Indirect effects to goshawk abundance and distribution can be affected by habitat alteration from treatment activities that affect canopy cover density, forest structure, understory condition, and availability of large trees. The availability of snags and down logs is also important to consider within goshawk and their prey species habitats. Additionally, broken snags and logs provide important structures used for plucking prey species, such as birds and small mammals.

The indirect effects of the project alternatives to goshawk nesting and foraging habitat will be described at two spatial scales: 1) the PAC and 2) the Sagehen Project Wildlife Analysis Area. The metrics or considerations for analyzing indirect effects are as follows:

- Changes to CWHR Type, Size Class, and Canopy Cover
- Snags and Downed Log Abundance
- Habitat Fragmentation and Structural Diversity
- Forest Resiliency

<u>Indirect Effects to Goshawk Protected Activity Centers (PAC)</u>

The Sierra Nevada Forest Plan Amendment Record of Decision (SNFPA ROD 2004) directed the Sierra Nevada national forests to designate Protected Activity Centers surrounding all known and newly discovered breeding territories detected on National Forest System lands. PAC boundaries include known and suspected nest stands and encompass the best available 200 acres of forested habitat. Within the Sagehen Basin there are five goshawk nesting territories: Lower Sagehen PAC (D57T01), Upper Sagehen PAC (D57T06), BGB PAC (D57T21, NE Sagehen PAC (D57T23), and Switchback PAC (D57T22).

Figure 3.6 displays the PACs within the analysis area and the proposed treatment units under Alternative 1, the Proposed Action.

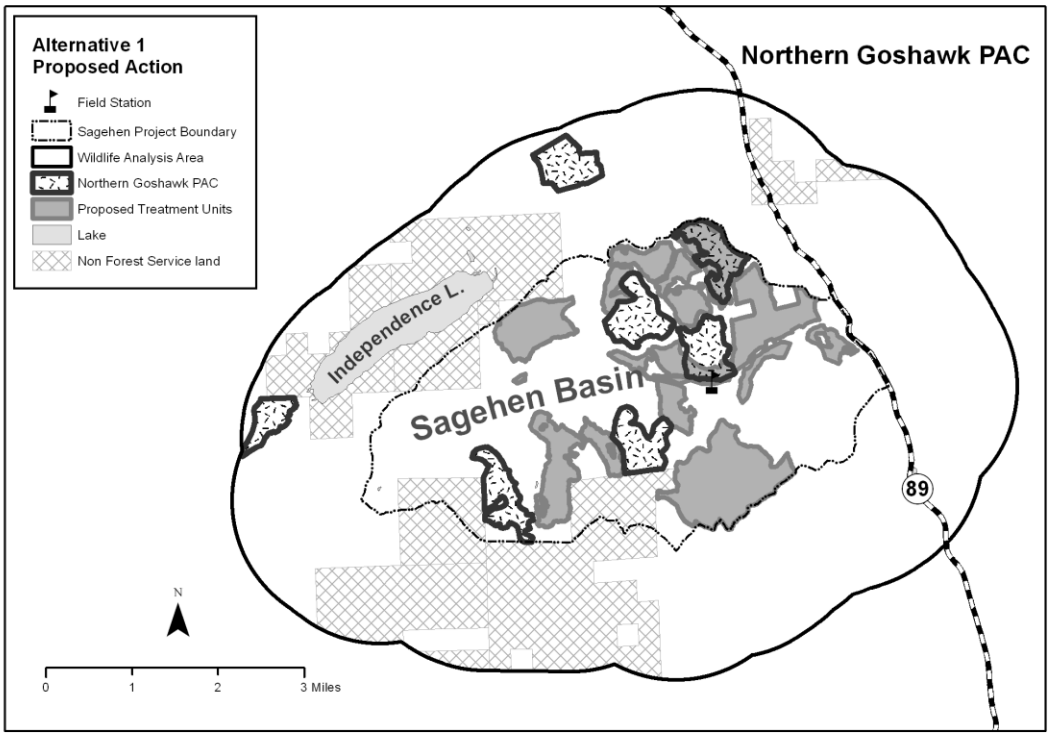


Figure 3.6. Northern Goshawk PACs and Proposed Action Treatment Units

Amendments to the Forest Plan

Northern Goshawk Protected Activity Centers: Existing Forest Plan direction for fire and fuels management relative to goshawk PACs includes the following: "Avoid PACs to the greatest extent possible when locating area treatments." Furthermore, the Forest Plan provides management direction (S&Gs 71, 72, 73, 74) for mechanical treatments within PACs.

Standard and guideline 71 provides direction on choices about which PACs to enter, when treatment areas must intersect PACs, using criteria to preferentially avoid PACs that have the highest likely contribution to owl productivity. All the goshawk PACs in the Basin rank as the "highest contribution to productivity" as all have had reproduction in recent years and therefore should have a lower priority for treatment, according to the Forest Plan.

The NE Sagehen PACs is proposed for mechanical treatment, and therefore, the Forest Plan would need to be amended to allow treatments within this PAC. For more information on the project-level non-significant Forest Plan Amendment, see Chapter 3, FONSI Element 10. No mechanical treatments are proposed within Upper Sagehen, BGB, or Switchback goshawk PACs under Alternatives 1, 2, 3, and therefore, there would be no indirect effects of habitat alteration within these PACs. This would be consistent with Forest Plan direction to "avoid mechanical treatments within PACs." Additionally, the Lower Sagehen PAC would also be consistent with Forest Plan direction standard and guideline #72 which states "Mechanical treatments may be conducted to

meet fuels objectives in PACs located in WUI defense zones…" since, this PAC is just north of the Sagehen Field Station, and is located within the WUI defense zone.

The NE Sagehen Goshawk PAC falls entirely within the WUI threat zone. Forest Plan direction (standard and guideline 72) states "In PACs located in WUI threat zones, mechanical treatments are allowed where prescribed fire is not feasible and where avoiding PACs would significantly compromise the overall effectiveness of the landscape fire and fuels strategy. Mechanical treatments should be designed to maintain habitat structure and function of the PAC." Alternative 1 proposes to mechanically treat a portion of the NE Sagehen PAC as part of the landscape fire and fuels strategy. (Refer to the Sagehen Project Fire/Fuels Report Addendum (April 29, 2013) for a discussion of how this PAC fits within the landscape-scale fire and fuels strategy.) However, a Forest Plan amendment is needed because Alternative 1 proposes treatments that go beyond a fire and fuels strategy, utilizing concepts from GTR-220 and GTR-237 (North et al. 2009, North et al. 2012), with the specific objectives to improve wildlife habitat for mature forest associated species, such as the goshawk. These treatments include forest management aimed at promoting forest resiliency and patch-scale heterogeneity for fuels and ecological restoration objectives. Specific proposed treatments include legacy tree treatments to promote the development and growth of larger trees; variable thinning, early seral openings, and dense cover areas to promote forest heterogeneity; and decadent feature enhancements to increase snag densities.

Standard and guideline 73 also states, "Treatments in the remainder of the PAC (outside of the 500-foot radius buffer) use the forest-wide standards and guidelines for mechanical thinning." Forest Plan direction for mechanical thinning treatments within PACs states, "where treatment is necessary, remove only material needed to meet project fuels objectives. Focus on removal of surface and ladder fuels." As previously stated, proposed treatments for the NE Sagehen PAC, go beyond objectives for fuels hazard reduction, and therefore a Forest Plan Amendment is needed. Otherwise proposed mechanical thinning treatments within the NE Sagehen PAC would conform to Forest Plan direction (S&G 6, 7, 8).

Indirect effects to the Lower Sagehen PAC and the NE Sagehen PAC

Lower Sagehen Goshawk PAC

The Lower Sagehen PAC falls within the WUI defense zone, where hand thinning is proposed for Unit 282 under Alternatives 1 and 3. WUI defense zones are the areas in closest proximity to communities, areas with higher densities of residences, commercial buildings, and/or administrative sites with facilities. The Sagehen Field Research Station lies within the WUI defense zone adjacent to the Lower Sagehen PAC. Out of a total of 108 acres proposed for thinning in Unit 282, approximately 54 acres of suitable goshawk nesting habitat and 2 acres of suitable foraging habitat would be hand thinned. With the exception of 3 acres, 51 acres would retain the current CWHR canopy classification. Three acres of suitable nesting habitat would change from CWHR 4D to 4M, where the canopy cover would fall below 60%. All of the 54 acres of suitable nesting habitat would remain suitable following thinning treatments. Two acres of foraging habitat would not change in canopy cover classification. Overall, canopy cover would change from a unit average of 76% to 59%

for unit 282 where fuels where the risk to wildfires would be lowered while maintaining suitable habitat conditions for the goshawk under both Alternatives 1 and 3.

NE Sagehen Goshawk PAC

In 2011, an active goshawk nest with one fledgling was discovered, necessitating the designation of a new northern goshawk protected activity center (PAC). This PAC, known as the NE Sagehen goshawk PAC, encompasses all of Unit 39 (32 acres) and those portions of Unit 38 within emphasis areas 1, 4, and 5 (160 acres). The emphasis area 7 portions of Unit 38 (50 acres) are not within the PAC. Under Alternative 1, a portion of this PAC (160 acres in Unit 38) is proposed for mechanical thinning followed by prescribed underburning.

Alternative 1 proposes to amend the Forest Plan by implementing proposed treatments within the NE Sagehen Goshawk PAC, figure 3.7 below, since the Forest Plan directs the Sierra Nevada forests to only conduct treatments needed to meet fuels objectives. Proposed treatments within the PAC would go beyond simply meeting fuels objectives and would be beneficial to goshawk and their habitats by also increasing forest structural diversity, create snags, and promote resilient forests conditions, in addition to reducing fuels hazards. The creation of early seral openings would potentially improve goshawk prey species habitat by regenerating and enhancing shrub species abundance. Legacy tree treatments would also reduce fuels, but would specifically be aimed at developing larger trees.

The NE Sagehen Goshawk PAC lies entirely within the WUI threat zone, where mechanical treatments proposed under Alternative 1 include variable thinning, legacy tree treatment, suppressed cut, decadent feature enhancement, dense cover areas, early seral openings, and underburning. The implementation of Alternative 1 would treat 132 acres of nesting habitat and 7 acres of foraging habitat (Table 27). Out of 132 acres of suitable nesting habitat, 93 acres would change from CWHR 4D to 4M post-treatment, and 39 acres of CWHR 4M would stay 4M post-treatment. Thinning treatments within Unit 38 would change canopy cover from 71% to 50.3% resulting in the short-term reduction in habitat quality. The core area of the PAC lies within Unit 39, and this unit is no longer proposed for treatment under any of the alternatives. Hence, the existing canopy cover of 71 percent in Unit 39 would be retained. The average residual canopy cover within the entire PAC, including Units 38 and 39 combined would be 53.4%. Suitable goshawk habitat post-treatment would not result in the loss of suitable habitat. Understory vegetation would become more open from thinning treatments and underburning, which would provide more open forest conditions preferred for hunting by goshawk. Legacy tree treatments would promote the growth of larger trees which would provide more nesting structures. Decadent feature enhancements would enhance prey habitat and goshawk roosting/resting habitat by increasing the abundance and distribution of snags. Overall, when considered together, all the various treatments including delineating dense cover areas and creation of early seral openings would provide increased horizontal and vertical diversity that would be beneficial to goshawk for nesting and foraging in the long-term.

The NE Goshawk PAC would not be treated under Alternatives 2 and 3, and therefore indirect impacts to goshawk habitat would not occur as described under Alternative 1. However, the opportunity to develop more resilient forests, increase structural diversity, create snags, and reduce wildfire risk to protect and enhance goshawk habitat within the PAC would be foregone. Alternative 3 would have slightly greater benefits than Alternative 2, since 56 acres of suitable habitat within the Lower Sagehen PAC would receive fuels treatments.

Dense Cover Areas and Early Seral Openings in Goshawk PACs

As described in the proposed action, dense cover areas (DCAs) are small areas distributed within treatment units that provide continuous vertical and horizontal cover with a mixture of shrubs and trees along with large and small down wood, snags, and high stumps. DCAs would typically contain clumps of trees of various size classes as well as a variety of snag and down wood sizes. These DCAs, ranging in size from 0.25-1 acre, would contribute to/enhance within-stand horizontal and vertical structural diversity and provide important old forest and/or mid seral habitat elements within the HRCA.

ESOs would be comprised of dense young regenerating trees and/or shrubs to provide early successional habitat within larger stands managed for late successional or old forest habitat. ESOs, from 0.25-0.50 acre, would enhance within-stand age and species diversity. ESOs would be created by taking advantage of existing conditions, such as areas of sparse tree cover, thinner soils, or pockets of extensive tree mortality. Openings would be created by removing most or all of the existing trees and either planting or allowing natural shrub and/or tree regeneration to create an ESO of early successional habitat. Within ESOs (regeneration areas), prescribed fire would be applied to regenerate shrubs and create suitable areas for shade-intolerant tree species to regenerate.

For DCAs comprised of multiple sizes of trees, snags, and down wood, prescribed fire would be carefully applied to maintain key habitat elements, particularly snags and down wood. Underburning in DCAs comprised of multiple sizes of trees, snags, and down wood would likely result in some mortality of suppressed and subdominant trees. Burning prescriptions would be designed to ensure the overall structure of the DCA would remain intact.

Under Alternative 1, approximately 19 acres of DCAs within the PACs would be designated for retention (13 acres – Unit 38, 6 acres – Unit 282) and would continue to provide areas of higher canopy, vertical and horizontal structure, down wood, snags, and high stumps in their existing condition. The 7 acres of ESOs scattered across Unit 38 in the PAC would result in removal of all existing trees and would eventually be planted or naturally regenerate over time. Therefore, the CWHR vegetation class in ESOs would likely remain the same as the current existing vegetation following treatment. However, the CWHR tree size and canopy classes would be reverted to early seral openings following treatments, as all trees would be removed. However, it is expected that the ESOs would eventually become forested and not result in long-term type conversion.

Additionally, the ESOs would not alter or change the habitat suitability for Northern goshawk across the units or would not result in habitat fragmentation at the landscape level. These DCAs and ESOs combined with variable thinning, legacy tree treatments, suppressed thinning, and associated fuels treatments would result in a more diverse and resilient landscape within and surrounding the PACs, although localized effects from the treatments would vary depending upon the size of the openings and site-specific conditions. Generally, the creation of early seral openings would be expected to result in increased shrubs, which would benefit prey species diversity. The overall effects to both the NE Sagehen Goshawk and the Lower Sagehen Goshawk PACs would be minimal, since the openings are small and scattered.

Alternative 1 would provide more structural diversity within the NE Sagehen PAC by the delineation of both DCAs and ESOs scattered throughout the 210 acres of Unit 38 compared to both Alternatives 2 and 3. Under Alternative 3, Non-commercial Alternative, a total of 6 acres of DCAs are proposed within Unit 282 (108 acres) where hand thinning is proposed. There would be no ESO treatments proposed within the Lower Sagehen PAC for Alternatives 1 and 3. For Alternative 2, No Action, there would be no implementation of DCAs or ESO and the PACs would remain in the existing condition and would not provide for increased vegetation structural and age class diversity across the 210-acre PAC.

Indirect Effects to Suitable Goshawk Habitat

Suitable goshawk foraging and nesting habitat were assessed for potential effects of proposed treatments for the action alternatives. Under Alternative 1, 1,792 acres of suitable nesting habitat and 798 acres of foraging habitat are proposed for thinning out of the total 2,621 acres. In addition, 64 acres would be treated that are not suitable for foraging or nesting. Of the 1,792 acres of suitable nesting habitat, thinning and fuels treatments, including variable thinning, legacy tree treatments, and suppressed cutting would result in 881 acres of CWHR 4D that would change to 4M, where canopy cover would be reduced below 60%. Within Unit 33, 35 acres would change from 4D to 4P and 17 acres would change from 4M to 4P where canopy cover would fall below 40% within the Emphasis Area, but the overall residual canopy cover for Unit 33 would be above 40% following treatments. A total of 292 acres would result in retaining canopy cover >60% (3D, 4D, 5D) post-treatment and another 581 acres would remain in the 4M canopy class (40-50%). All 1,792 acres of suitable nesting habitat would retain nesting habitat suitability, but would be reduced in quality in the short-term. Within 822 acres of suitable foraging habitat, canopy cover would be reduced, but would remain suitable and would retain their present canopy cover classification following treatments. Current unit average canopy cover ranges from 51% to 80% and post-treatment average canopy cover would range from 41% to 71%.

Under Alternative 3, Non-commercial Alternative, a subset of Alternative 1 units would be proposed for treatment to meet fuels objectives, where 1,132 acres of suitable nesting habitat would result in lowered canopy cover in the short term. All 1,132 acres would remain suitable, but habitat quality would be lowered in the short-term. Approximately 168 acres of nesting habitat would retain canopy cover levels >60%, 187 acres of nesting habitat would change in CWHR type 4D to 4M, and

349 acres would remain as CWHR 4M following treatments. The quantity of suitable foraging habitat would remain unchanged following hand thinning treatments and follow-up fuels treatments such as, prescribed fire and mastication where treatment involves removal of small diameter trees that would not result in a significant change in canopy cover or tree class.

Under Alternative 3, the opportunity to increase and enhance forest resiliency and structure diversity would not be achieved on 1,521 acres that are proposed for treatment under Alternative 1. The average unit canopy cover for Alternative 3 currently ranges from 51% to 76%. Average canopy cover for the units following treatments would range from 41% to 71%.

Under Alternative 2, No Action, 2,621 acres suitable nesting and foraging habitat would not be treated and therefore, canopy cover would not change or be reduced in quality. However, forest resiliency, forest structural diversity, and reduced fuels hazard would not be realized under the No Action Alternative. Stand density reduction would not occur and therefore, legacy tree treatments that would promote the growth and protection of large, old trees important for nesting would not occur. In the long-term, goshawk nesting and foraging habitat, including those within and surrounding the five goshawk PACs, would remain at a higher risk of potentially severe wildfire effects under the No Action Alternative.

As shown in Table 3.13 below, for Alternative 1, 292 acres would remain unchanged in the CWHR 5D/4D/3D types, 881 acres would change from CWHR 4D to 4M, 35 acres would change from 4D to 4P, 581 acres of 4M types would remain unchanged, and 17 acres would change from CWHR 4M to 4P types. Although Emphasis Area 6 within Unit 33 would reduce canopy cover to 38% post-treatment, the average canopy across the unit would result in a post-treatment canopy cover of 44%, and would therefore meet Forest Plan standards and guidelines for mechanical thinning. All 2,621 acres of suitable goshawk nesting habitat would be reduced habitat quality, as stated above. However, treatments would result in increased structural diversity and forest resiliency through reduced hazard fuels while maintaining large trees and moderate canopy cover required for nesting. On 822 acres of foraging habitat there would be no change in habitat quantity, but would result in slight canopy reductions from hand thinning and fuels treatments. The understory structure would be more open from various fuels treatments which would benefit goshawk prey species in the short-term.

For Alternative 3, 1,132 acres of suitable nesting habitat proposed for treatments would result in 168 acres that would remain as CWHR 5/4/3D, 349 acres would stay as CWHR 4M, and 187 acres would change from CWHR 4D to 4M following treatments, where habitat quality would be reduced. The quantity of suitable nesting habitat would be unchanged post-treatment. On 391 acres of suitable foraging habitat quantity and post-treatment CWHR types would remain unchanged.

Alternative 3, 1,132 acres of suitable nesting habitat proposed for treatments would result in 168 acres that would remain as CWHR 5/4/3D, 349 acres would stay as CWHR 4M, and 187 acres would change from CWHR 4D to 4M following treatments, where habitat quality would be reduced. The

quantity of suitable nesting habitat would be unchanged post-treatment. On 391 acres of suitable foraging habitat quantity and post-treatment CWHR types would remain unchanged.

Table 3.15. Acre Summary of Changes to CWHR types within Suitable Northern Goshawk Nesting and Foraging Habitat									
Unit	Unit Acres	High and Moderate Quality Nesting					Moderate Quality Foraging		
		Post-treatment Acres of CWHR Class Unchanged (5/4/3D remaining 5/4D)	Post-treatment Acres of Changes in CWHR Class (4D to 4M)	Post-treatment Acres of Changes in CWHR Class (4D to 4P)	Post-treatment Acres of CWHR Class Unchanged (4M remaining 4M)	Post-treatment Acres of Changes in CWHR Class (4M to 4P)	Post-treatment Acres of CWHR Class Unchanged (3/4P remaining 3/4P)	Post-treatment Acres of CWHR Class Unchanged (2/3/4S remaining 3/4S)	Post-treatment Acres of CWHR Class Unchanged (3M remaining 3M)
33	118	8	41.9	35.2	8.5	17	7.3	0.4	0
34	68	3	58.0	0.0	1.0	0	6.3	0.0	0
35	64	3	24.84	0.0	10.9	0	25	0	0
36	101	2	44.6	0.0	48.2	0	11.4	0	0
38	210	6	108.4	0	59.9	0	24.4	4.7	0
39	32	21	0.0	0.0	5.7	0	29.1	0	0
46	621	0	88.3	0.0	236.3	0	192.5	53.5	28
47	33	0	0.9	0.0	3.4	0	4.2	24.8	0
61	20	20	0.0	0.0	0.0	0	0	0	0
73	144	6	77.3	0.0	36.8	0	6.0	1.7	0
76	91	0	3.3	0.0	20.9	0	49.5	6.1	0
80	5	0	4.9	0.0	0.0	0	0.2	0	0
85	64	0	6.4	0.0	0.0	0	52.9	3.4	1
87	207	0	0.1	0.0	0.1	0	0.0	0.4	196
89	34	45	0.0	0.0	0.0	0	2.2	0.7	0
90	40	1	34.0	0.0	3.8	0	0.8	0	0

91	9	0	13.4	0.0	8.7	0	0.0	0.3	0
98	63	45	0.0	0.0	0.0	0	0.5	0.3	4
99	67	30	29.8	0.0	0.0	0	0.6	2.8	2
100	120	37	33.9	0.0	30.0	0	9.4	7.5	0
156	84	4	47.9	0.0	21.6	0	7.5	0	0
163	82	6	55.9	0.0	14.4	0	4.5	6	0
213	268	19	189.3	0.0	21.3	0	36.4	1.6	0
282	108	35	17.4	0.0	49.6	0	4.6	1.4	0
Total	**2653**	**292**	**880.6**	**35**	**581.1**	**17**	**475.3**	**115.6**	**231**
Alternative 3									
46	621	0	88.3	0.0	236.3	0	192.5	53.5	28
47	33	0	0.9	0.0	3.4	0	4.2	24.8	0
61	20	20	0.0	0.0	0.0	0	0	0	0
76	91	0	3.3	0.0	20.9	0	49.5	6.1	0
91	9	0	13.4	0.0	8.7	0	0.0	0.3	0
98	63	45	0.0	0.0	0.0	0	0.5	0.3	4
99	67	30	29.8	0.0	0.0	0	0.6	2.8	2
100	120	37	33.9	0.0	30.0	0	9.4	7.5	0
282	108	35	17.4	0.0	49.6	0	4.6	1.4	0
Total	**1,132**	**168**	**187.0**	**0**	**348.9**	**0**	**261.3**	**96.7**	**33**

Dense Cover Areas (DCAs) and Early Seral Openings (ESOs) in Suitable Goshawk Habitat

DCAs are areas that are delineated within treatment areas that will remain intact and provide high to moderate quality goshawk foraging habitat which typically provide areas of higher canopy cover and larger trees compared to the surrounding areas. Alternative 1 proposes to delineate a total of 78 acres of DCAs, of which 0.4 acres are not suitable, 73 acres are high and moderate quality nesting habitat, and 7 acres are moderate quality foraging habitat for the goshawk.

Alternative 1 proposes to create a total of 54 acres of ESOs, of which 48 acres (89%) are high and moderate quality nesting, and 6 acres (11%) are moderate quality foraging habitat for the goshawk. The ESOs would result in removal of all existing trees and would eventually be planted or naturally regenerate over time. Therefore, the CWHR vegetation class in ESOs would likely remain the same as the current existing vegetation following treatment. However, the CWHR tree size and canopy classes would be reverted to early seral openings following treatments, as all trees would be removed. However, it is expected that the ESOs would eventually become forested and not result in long-term type conversion. Additionally, the ESOs would not alter or change the habitat suitability for goshawk across the treatment units or would not result in habitat fragmentation at the landscape level. These DCAs and ESOs combined with variable thinning, legacy tree treatments, suppressed thinning, and associated fuels treatments would result in a more diverse and resilient landscape within suitable goshawk habitat, although localized effects from the treatments would vary depending upon site-specific conditions.

Both Alternatives 1 and 3 would designate a total of 28 acres of DCAs within fuels treatment units (Units 61, 91, 98, 99, 100, 282). Out of 573 acres proposed for fuels treatments in these units, 342 acres (60%) are suitable goshawk nesting habitat and 33 acres (6%) are suitable for foraging. It can be assumed that the DCAs represent a relatively similar proportion of nesting and foraging habitat within the fuels treatment units, since specific habitat data for DCAs within fuels treatment units was not available for this analysis. Under Alternative 3, increased structural diversity from DCAs would only occur across 573 fuels treatment acres compared to the 1,664 acres in Alternative 1 (Units 33, 34, 35, 36, 38, 61, 73, 85, 89, 90, 91, 156, 163, 213, 282) where the combination of DCAs and ESOs would contribute to more resilient forests and heterogeneity across the landscape. Alternative 2 would provide no change in forest structural diversity across the landscape, but would have the least short term impacts to goshawk habitat in the short-term since no ESOs would be created where all the trees would be harvested.

Snags and Down Logs

Snags and down logs were analyzed in the section *Effects Common to All Wildlife*. Generally, Alternative 1 would maintain all existing snags >15 inch dbh, except for those needing to be removed for equipment operability or those that pose a risk public safety. It is expected that there would be no measurable difference in the number of snags greater than 15 inches dbh between the existing condition and the immediate post treatment condition.

The Forest Vegetation Simulator model projected that Alternative 1 would result in lower snag abundance compared to Alternatives 2 and 3 within 30 and 50 years after treatment. Generally, Alternative 2 would result in the most snags compared to Alternatives 1 and 3, 30 and 50 years post-treatment. In all cases, the snag densities projected at 30 and 50 years post-treatment would retain snag densities per Forest Plan standards and guidelines throughout the Sagehen Basin under all the alternatives.

Conclusion and Determination

The Sagehen Project uses concepts from GTR-220 and GTR-237 which strive to promote long-term ecosystem restoration, forest resiliency, and fuels reduction while using innovative vegetation treatments that enhances and retains suitable goshawk habitat across the analysis area. The Sagehen Project, as proposed, would:

- Maintain suitable nesting, roosting, and nesting habitat within the NE Sagehen and Lower Sagehen Goshawk PACs and throughout the treatment units in the long-term. Treatments as proposed under Alternatives 1 and 3 would result in the short-term reduction in habitat quality while promoting long-term sustainability and resiliency of habitat by treatments specifically designed to improve goshawk habitat such as, legacy tree treatment, fuels reduction, increased horizontal and vertical structural diversity, and decadent feature enhancement.
- Retain high and moderate quality nesting and roosting habitat that are dominated by large trees, moderate to high canopy cover, abundance of snags and downed logs, and therefore promote goshawk occupancy and reproductive success.
- Maintain and create habitat for goshawk prey species, particularly, birds and small mammals through various treatments, including dense cover areas , early seral openings, snag creation, and retention of shrubs.
- Promote forest resiliency and patch-scale heterogeneity to meet fuels and ecological restoration objectives while enhancing and maintaining goshawk habitat in the long-term.
- Forest management and fuels reduction strategies uses slope, topographic position and aspect that would result under a natural disturbance regime may benefit goshawk in the long-term, with the acknowledgement that short-term impacts to goshawk may occur.

  Implementation of Alternatives 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the Northern goshawk within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the Northern goshawk as discussed previously in this evaluation, and professional judgment.

WILLOW FLYCATCHER

Status: USFS R5 Sensitive

The willow flycatcher (*Empidonax trailii*) is listed on the USFS R5 Sensitive Species List for Tahoe National Forest. There are three subspecies of willow flycatcher in different portions of California;

they have been distinguished from each other based on distribution and color. In the Sierra Nevada, *E. t. adastus* and *E. t. brewsteri* generally occupy the eastern and western slopes, respectively; both of these subspecies likely occur in Tahoe National Forest (Green et al. 2003). The southwestern willow flycatcher, *E. t. extimus*, occupies southern California as well as other southwestern States and was listed as endangered by the USFWS in 1995 (USDI Fish and Wildlife Service 1995; 60 FR 10694).

In accordance with the SNFPA Record of Decision (USDA Forest Service 2001), a Conservation Assessment of the Willow Flycatcher in the Sierra Nevada was completed (Green et al. 2003). The Conservation Assessment summarized all known and relevant information pertinent to management of the willow flycatcher in the Sierra Nevada at the time of its completion. A Conservation Strategy for the Willow Flycatcher in the Sierra Nevada is currently being produced. Willow flycatcher monitoring and demographic analysis has been conducted in the central and northern Sierra Nevada since 1997 under a cost share agreement between Texas A&M University and the USFS Region 5; each year progress reports and a year-end annual report on the results are produced.

The willow flycatcher was once a common summer resident throughout California where suitable habitat existed; areas where it was most common included the Central Valley and central California in general, and the southern coastal region (Grinnell and Miller 1944, Harris et al. 1987). Observed declines in breeding populations have been a growing concern for over four decades and it is now limited to scattered meadows of the Sierra Nevada and along the Kern, Santa Margarita, and San Luis Rey Rivers (Harris et al. 1987). As of completion of the Conservation Assessment in 2003, estimates of the willow flycatcher population in the Sierra Nevada bioregion ranged from 300 to 400 individuals, with 120 to 150 individuals on National Forest System land (summarized in Green et al. 2003). Most of the remaining breeding populations of willow flycatchers in the Sierra Nevada occur in isolated mountain meadows up to 8000 feet elevation (Serena 1982, Harris et al. 1988, Stafford and Valentine 1985, Bombay 1999, Bombay et al. 2001). The highest recorded number of territories on National Forest System land in the Sierra Nevada bioregion is located in the Perazzo Meadows area in Tahoe National Forest. Systematic surveys and research on willow flycatchers have occurred throughout the Perazzo Meadow area since the early 1980s (eg. Serena 1982, Flett and Sanders 1987, Harris et al. 1987, Sanders and Flett 1989, Bombay et al. 2003, Mathewson et al. 2009).

The willow flycatcher is a small passerine Neotropical migrant that breeds during summer in riparian deciduous shrub habitat generally dominated by willows in the United States and Canada, and winters in tropical and subtropical areas from southern Mexico to northern South America (as summarized in Green et al. 2003). Willow flycatchers in the northern Sierra Nevada typically begin arriving on their breeding grounds around the 1st of June, and egg laying for first nest attempts sometimes begins as early as the second week in June, but more often in late June/early July (summarized in Green et al. 2003). Up to three nesting attempts may occur as a result of nest failure, with egg-laying through the 1st week of August, and all willow flycatchers appear to be gone from their breeding territories by mid-September (summarized in Green et al. 2003).

Breeding habitat typically includes moist meadows with perennial streams and smaller spring fed or boggy areas with willow or alders; dense thickets are generally avoided in favor of more patchy

willow sites providing considerable edge (summarized in Green et al. 2003). Bombay et al. (2003) found that riparian shrub cover was the primary predictor of habitat selection at the meadow, territory, and nest site scales, and that increased shrub cover also predicted both abundance and territory success. Willow flycatcher nesting success is strongly associated with standing or flowing water or heavily saturated soils (summarized in Green et al. 2003). Meadow size seems to be an important factor for willow flycatcher use. Willow flycatchers in the Sierra Nevada use meadows ranging from 1 to 719 acres; more than 80% of territories occur in meadows greater than 20 acres (Serena 1982, Harris et al. 1987, Harris et al. 1988, Bombay 1999, Green et al. 2003). Willow flycatchers have also been found in riparian habitats of various types and sizes ranging from small lakes or ponds surrounded by willows with a fringe of meadow or grassland, to willow lined streams, grasslands, or boggy areas.

Potential risk factors include management activities that may affect the current habitat, distribution, and abundance of willow flycatchers in the planning area. Activities that have the potential to alter willow flycatcher habitat including changes to meadow hydrology, stream bank alteration, changes to vegetation structure and composition. Activities that have the potential to affect willow flycatcher habitats are livestock grazing, roads, and recreation that affect meadow/willow systems, such as OHV use.

There are approximately 80 acres of potentially suitable willow flycatcher habitat mapped within the Sagehen Basin located along Sagehen Creek within stringer meadows and willow habitat, extending from Highway 89 to Sagehen Creek Campground. Although, 80 acres of meadow and willow habitat is mapped as potentially suitable for willow flycatchers, not all 80 acres are actually suitable for nesting. An estimated fifty percent of meadow/willow habitat is dryer and does not have standing water at the surface throughout the breeding season that is characteristic of high quality willow flycatcher nesting habitat. The fens at Sagehen have water saturated to the surface throughout the breeding season, including at Mason and Kiln fens. However, the fens have very little willow habitat; and the scattered clumps of willow species found within the fens is the low-growing Eastwood's willow (*Salix eastwoodieae)*, which is not preferred for nesting and foraging by willow flycatcher. In general, willow flycatchers tend to nest and forage in the taller Lemon's willow (*Salix lemmonii*) or Geyer's willow (*Salix geyeriana*), which are found along the mainstem of Sagehen Creek.

The Forest Plan directs the Sierra Nevada Forests to conduct surveys for willow flycatchers within occupied habitat. Willow flycatcher surveys were conducted to Regional protocol between the years of 2001 and 2008. In 2002, a single male was detected in the section between Highway 89 and the Sagehen Field Station. In subsequent years following the 2002 detection, willow flycatchers have not been detected within the Basin.

Direct Effects and Indirect Effects

There is a low potential for willow flycatchers to be directly affected by project activities under Alternatives 1 and 3, since willow flycatchers have not been detected in the vicinity since 2002. Surveys conducted between 2005 and 2008 did not result in locating any willow flycatchers within Sagehen Basin. However, proposed project activities in units that are adjacent to Sagehen Creek

(Units 98, 99, 100, 282) have the potential to directly disturb willow flycatchers during the breeding season (May-Sept.) when proposed treatments are conducted. Treatments within these units are all hand treatments, and therefore, disturbance to willow flycatcher would be relatively minor, except for 45 acres of mastication proposed within Unit 99. Direct disturbance to willow flycatcher is likely to be short-term and would not all happen at the same time, since treatment units would be harvested at different times. Willow flycatcher habitat would not be altered or affected from proposed activities under Alternatives 1 and 3, since no treatments are proposed within willow flycatcher habitats. Alternative 2, No Action, would not directly, indirectly, or cumulatively affect the willow flycatcher, since no activities are proposed.

Conclusion and Determination

Implementation of Alternatives 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the willow flycatcher within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the willow flycatcher as discussed previously in this evaluation, and professional judgment.

PACIFIC MARTEN

Status: USFS R5 Sensitive

The Pacific marten (*Martes caurina*) is listed on the USFS R5 Sensitive Species List. The marten historically occurred in forests throughout North America, experienced reductions in portions of its range due to intensive trapping and reduction in habitat quality, and has since been reestablished in portions of the historic range with natural expansions and with the aid of translocations (summarized in Kucera et al. 1995). Recent genetic and morphological evidence has warranted splitting the Pacific marten into two species: the Pacific marten east of the Rocky Mountain crest (*Martes caurina*) and the Pacific marten (*M. caurina*) west of the crest (Dawson and Cook 2012). Two subspecies of the Pacific marten are recognized in California: the Sierra marten (*M. c. sierrae*) in the Sierra Nevada, Cascades, and Klamath/Trinity mountains, and the Humboldt marten (*M. c. humboldtensis*) in the redwood zone along the north coast. In California, marten were trapped for fur until prohibited in 1946 in the extreme northwestern portion of the state, and throughout the State in 1953 (summarized in Kucera et al. 1995). The Humboldt marten was thought to be possibly extinct from the coastal range at one time (refer to Kucera et al. 1995, and Zielinski and Golightly 1996 as cited in Zielinski et al. 2001), but marten are now known to exist in a small area in California's north coast range (Zielinski et al. 2001, Slauson 2003, Slauson et al. 2007). Besides the Humboldt marten and two other subspecies in eastern Canada, most of the other known subspecies appear to be well distributed within their geographic ranges, including the Sierra Nevada population (Zielinski et al. 2001). Marten are known to exist in suitable habitat on all the National Forests in the Sierra Nevada Province; however, Zielinski et al. (2005), based on recent survey data, report a gap in the current distribution centered on Plumas County which was not historically present.

In the Sierra Nevada marten generally occur at elevations of ~4,500 feet to 10,500 feet, averaging 6,600 feet. Kucera et al. (1995) describe the distribution of the marten in California from eastern

Siskiyou and northwestern Shasta Counties through the western slope of the Sierra Nevada to northern Kern County, and on the eastern slope of the Sierra Nevada as far south as central-western Inyo County. In the southern Cascades and northern Sierra Nevada, Kirk (2007) noted that 85% of contemporary marten detections in his analysis occurred above 6,000 feet elevation (despite a reduced survey effort at these higher elevations), 15% of detections were between 3,000 and 6,000 feet, and no detections of marten occurred below 3,000 feet elevation.

Preferred forest types in the Sierra Nevada include mature mesic forests of red fir, red fir/white fir mix, lodgepole pine, subalpine conifer, and Sierran mixed conifer (Freel 1991). CWHR types 4M, 4D, 5M, 5D, and 6 are moderate to highly important for the marten (USDA Forest Service 2001). Analysis of effects to marten weighs heavily on the preferred habitat types, but consideration is given for the utilization of other marginal habitat types. Forest stands dominated by Jeffrey pine do not appear to support marten in Tahoe National Forest (Martin 1987), as evidenced by the lack of marten detections in pure eastside pine (some of which were adjacent to mixed conifer stands which did contain marten detections) during systematic surveys conducted on the eastside of Tahoe National Forest (data on file at Sierraville Ranger District).

Preferred habitat is generally characterized by dense canopy, multi-storied, multi-species late seral coniferous forests with a high number of large (> 24 inch dbh) snags and downed logs (Freel 1991). Late- and old-structure forests (with larger diameter trees and snags, denser canopy and more canopy layers, and plentiful course woody material) are thought to provide ample rest and den sites, protection from avian and mammalian predators, and foraging sites (Bull et al. 2005). Data from some studies shows that use of habitat by marten does not necessarily rely on high levels of canopy cover, but likely involves a complex interaction of habitat variables, at both small and large scales, which provide for their life history requirements and minimizes the risk of predation on them (refer to Soutiere 1979, Drew 1995, Chapin et al. 1997, and Slauson 2003). Koehler and Hornocker (1977) suggested that while open meadows and burns may be avoided by marten in winter when they are under a heavy snowpack, these areas may be used in the summer, or in low snow years, if they provide adequate cover and food.

Marten have been found to be generally associated with mesic conifer-dominated forest conditions (eg. Spencer et al. 1983, Martin 1987, Buskirk et al. 1989, Wilbert et al. 2000, Mowat 2006, Baldwin and Bender 2008). Studies in the Sierra Nevada indicate martens have a strong preference for forest-meadow edges, and riparian forest corridors used as travel ways appear to be important for foraging (Spencer et al. 1983, Martin 1987). Spencer et al. (1983) found that in the lower Sagehen Creek basin on the eastside of Tahoe National Forest below approximately 6,700 feet elevation, marten strongly preferred riparian lodgepole pine habitat and selected against brush, mixed conifer, and Jeffrey pine habitats; riparian areas were used more for activity than resting, and mixed conifers were used more for resting than activity. In the upper Sagehen basin above approximately 6,700 feet elevation, marten were found to strongly prefer red fir habitat associations for both resting and activity (Spencer et al. 1983). Spencer et al. (1983) found that marten preferred forest stands with 40-60% canopy cover at both resting and foraging sites and avoided stands with less than 30% canopy cover.

Coarse woody debris is an important component of marten habitat, especially in winter, by providing structure that intercepts snowfall and creates subnivean tunnels, interstitial spaces, and access holes (Andruskiw et al. 2008). Zielinski et al. (1983) suggested that marten activity varied to allow them to take advantage of subnivean dens utilized by their prey. Sherburne and Bissonette (1993) found marten more likely to utilize subnivean access points in areas that contained more abundant prey. They also found that when coarse woody debris covered a greater percent of the ground, marten use also increased (Sherburne and Bissonette 1993). Older growth forests with accumulated coarse woody debris provide the forest floor structure necessary to enable marten to forage effectively during the winter (Sherburne and Bissonette 1993).

Marten home ranges are large by mammalian standards, particularly for their size (Buskirk and Ruggiero 1994, Buskirk and Zielinski 1997). Martens exhibit a high level of variation in home range size throughout their range, and generally exhibit a low level of same-sex overlap (Bull and Heater 2001). From numerous studies across the range of the marten, Powell (1994) calculated the mean home range size for males of 2,000 acres and for females 570 acres (as cited in Powell et al. 2003). Marten home range sizes in the Sierra Nevada have been reported to vary from approximately 420 to 1,800 acres for males, and 170 to 1,400 acres for females (summarized data from Simon 1980, Spencer 1981, Martin 1987, and Zielinski et al. 1997 as reported in Buskirk and Zielinski 1997). Variation in home range size may be a function of prey abundance or habitat quality (Ruggiero and Buskirk 1994). In northeastern Oregon, Bull and Heater (2001) found that home range size was not correlated to the amount of unharvested forest in their study.

Drew (1995) suggested that some fine-scale selection factor not linked to foraging strategy, such as minimizing the risk of predation by avoidance of open areas, appears to influence habitat selection, and recommended maintenance of landscape connectivity to prevent isolation of forest patches. Kirk (2007) found the best association for marten occurrence at the largest scale he modeled (30.9 mi^2), with amount of habitat, number of habitat patches, and land ownership category emerging as important variables, suggesting selection based upon broad scale landscape conditions. The size of openings that martens will cross in the Sierra Nevada or Cascades is currently under study (Zielinski 2013). However, in the Rocky Mountains, the average width of clear cuts (openings) crossed by martens was 460 ft; this distance is significantly less than the average width of clear cut openings that martens encountered but did not cross (average = 1,050 ft) (Heinemeyer 2002). Moreover, martens were more likely to cross larger openings (max distance = 600 ft.) that had some structures in them (i.e., isolated trees, snags, logs) than smaller openings (average distance = 160 ft) that had no structures (Heinemeyer 2002). Cushman et al. (2011) reported that snow-tracked martens in Wyoming strongly avoided openings and did not venture more than 55 feet from a forest edge.

In the Sagehen Creek basin in Tahoe National Forest, Moriarty et al. (2011) found that marten detections decreased from an average detection rate of 65% in the early 1980s (Spencer 1981, Zielinski 1981, Martin 1987) to 4% in her study conducted from 2007-2008, based on similar but not identical methodology. Analysis of prior research in this area showed that the distribution of marten detections changed spatially from a semi-uniform distribution in the upper and lower basin in 1980s to detections that were clustered in the southwest corner of the upper basin by the early 1990s

(Moriarty et al. 2011). The reasons for the apparent decrease in marten abundance were not clear, but may have included reduction of habitat quality, increase in habitat fragmentation, loss of important microhabitat features such as snags and down woody material, or other factors (Moriarty et al. 2009). From 1984-1990 more than 30% of the forested habitat in the Sagehen basin was impacted by various logging treatments (Moriarty et al. 2011). Moriarty et al. (2011) suggested that rather than amount of habitat (which did not change significantly), it is likely that the size of patch core areas, distance between patches, spatial configuration of patches, and microhabitat features within patches may be more important for marten persistence.

Marten natal and maternal den structures may occur in rock crevices, snags, squirrel middens, logs, artificial log structures, slash piles, squirrel nests, live trees, underground, and in at least one case a boulder field (Ruggiero et al. 1998, Bull and Heater 2000). In Wyoming, Ruggiero et al. (1998) found that red squirrel middens were strongly favored for parturition sites (56%) and were often associated with large-diameter logs and other course woody debris. Buskirk et al. (1989) found that in winter adult marten used subnivean resting sites located next to course woody debris in spruce-fir especially during colder temperatures and re-used the same resting sites more frequently, whereas juvenile marten rested more often in lodgepole pine stands without as much course woody debris and used the same resting sites less frequently. They suggested different use of resting sites by adults and juveniles as either due to exclusion of juveniles from preferred habitats due to territorial influences, or to experiential learning by juveniles over time as to what constitutes a good resting site (Buskirk et al. 1989). During periods of warmer temperatures, marten rested for shorter periods of time and showed increased use of rock fields (below snow surface) and above-ground locations such as snags for resting (Buskirk et al. 1989). Wilbert et al. (2000) found that use of subnivean versus supranivean resting sites increased with lower temperature and recent (previous 24 hours) snowfall. In their study in Wyoming, the mean diameter of trees and snags in which cavities were used for resting was 20” dbh, which was significantly larger than trees and snags used for resting on branches (mean dbh 13”) (Wilbert et al. 2000).

Prey species abundance is a critical component of the habitat and there is some dietary overlap with the fisher, particularly in the southern Sierra Nevada where they occur sympatrically (Zielinski and Duncan 2004). Both species prey heavily upon squirrels, but marten diet has been found to be diverse, including a variety of mammals, birds, reptiles, fish, insects, seeds, and fruits (Koehler and Hornocker 1977, Soutiere 1979, Hargis and McCullough 1984, Zielinski and Duncan 2004). Marten prey items vary seasonally and appears to depend on availability. Simon (1980) found insects dominating the diet in summer and fall, while Douglas squirrels (*Tamiasciurus douglasii*) provided the bulk of winter and spring nourishment. At Sagehen Creek, CA, within the Truckee Ranger District, Zielinski (1983) found microtine rodents the most frequent year-round prey. Chickaree, snowshoe hare, northern flying squirrel, and deer mouse were taken almost exclusively during the winter; and squirrels and chipmunks formed the largest component of the diet from late spring through fall. Hargis and McCullough (1984) found that marten diet differed by year (winter in their study) possibly related to prey availability and/or depending on environmental factors; there was a pronounced difference in winter precipitation and the snowpack in different years in their study. In the southern

Sierra Nevada, Zielinski and Duncan (2004) found that the marten and fisher diet is similar and highly diverse; the marten diet consisted of 34 distinguishable taxa of animals and plants, with squirrels the highest proportion at 22%. Moritz et al. (2008) investigated the effects of climate change over the past century in Yosemite National Park on small mammal distributions. They found variable elevational shifts amongst small mammal species (even for closely related species), but high-elevation species typically experienced range contractions from lower elevations (50% of high-elevation species) and low-elevation species typically expanded their range upward (50% of low-elevation species), a pattern expected with increased temperature (analysis of regional weather records indicate a 3.7° C (6.7° F) increase in average minimum monthly temperature over the past 100 years) (Moritz et al. 2008).

Numerous and heavily traveled roads are thought to be undesirable in order to avoid habitat disruption and/or animal mortality. Roads may decrease prey and food availability for marten as well as fisher (Allen 1987) due to prey population decreases resulting from road kills and/or behavioral barriers to movement. In Ontario, Robitaille and Aubry (2000) found that while martens were as likely to be detected near roads as they were away from roads, analysis of marten track density showed more activity away from roads, suggesting that marten movement differed when near roads. In his southern Cascades and northern Sierra Nevada study area, Kirk (2007) found that the amount of roads did not emerge as an important variable in his analysis of marten detections at varying scales. In a forest managed for timber harvest in Maine, Chapin et al. (1998) concluded that marten responded more strongly to forest fragmentation associated with clear-cut logging than to proximity to forest roads; the median density of roads in marten home ranges exceeded 1.3 mi/mi^2 in their study. In two study sites in California (Lake Tahoe Basin Management unit and Sierra National Forest), Zielinski et al. 2008 found that off-highway vehicle and over-the-snow vehicle use (at least up to 1 vehicle per 2-hour time period) had no effect to marten occurrence, circadian activity, or sex ratio. In west-central Alberta, Webb and Boyce (2009) found that no traplines with consistent marten harvests through time had >36% of the trapline developed; in their study roads and oil and gas wells were the primary form of development.

Marten have been detected throughout the Sagehen Basin since the early 1980s by various researchers, including Sandy Martin, Terri-Simon Jackson, Wayne Spencer, and Bill Zielinski. Concern regarding marten declines within the Sagehen Basin led to a research study on marten distribution and habitat changes over a 30 year period (Moriarity et al. 2011). During 2007 and 2008, systematic and comprehensive marten surveys were completed across the majority of the Sagehen Basin within mature to late-successional forests during a research study by Katie Moriarity. A variety of methods were used, including remotely sensed cameras, track plates, and genetic analysis from hair or scat samples. Areas dominated by younger forests, including plantations were not sampled. Marten were detected during 2008 between the months of January and March. The majority of marten detections were located in the southwestern portion of the uppermost Basin in forests dominated by red fir, lodgepole pine or mixed conifer forests comprised of a combination of white fire, lodgepole pine, and red fir. These marten detections encompassed approximately one-third of the total Basin area in areas that have the greatest concentration of high quality marten habitat. Marten have also been

detected by Forest Service biologists just north of the Basin on the Sierraville Ranger District in 2003 for the Phoenix Project planning and analysis. Moriarty et al. (2011) found that marten population declines within the Basin coincided with the period of intensive timber harvest between 1983 and 1990.

Suitable Marten High Quality Denning and Foraging Habitat Description and Analysis Area
Suitable marten habitat for analyzing the direct, indirect, and cumulative effects project alternatives was generated by modeling habitat using the current Tahoe NF vegetation map and Geospatial Interface tools for ArcGIS. The existing vegetation maps are classified using the CWHR classification system. During the Sagehen Project collaborative process, a marten subcommittee was convened to refine marten habitat suitability definitions as follows on Table 3.16 below.

Table 3.16. Definitions of High and Moderate Quality Marten Habitat within the Sagehen Basin (Moriarty 2009, modified)

Habitat	Forest Type	Size Class*	Canopy Closure**
High Quality			
	Lodgepole Pine (LPN)	4, 5	M, D
	Montane Riparian (MRI)	5, 6	M, D
	Red Fir (RFR)	4, 5	M, D
	Subalpine Conifer (SCN)	4, 5	M, D
	Sierran Mixed Conifer (SMC) – Fir dominated stands only	5, 6	M, D
	White Fir (WFR)	4, 5, 6	M, D
Moderate Quality			
	Eastside Pine (EPN) – with a lodgepole pine component only	4, 5, 6	P, M, D
	Eastside Pine (EPN)	5, 6	M, D
	Jeffrey Pine (JPN)	5, 6	M, D
	Lodgepole Pine (LPN)	4, 5	P
	Montane Riparian (MRI)	4	M, D
	Red Fir (RFR)	4, 5	P
	Subalpine Conifer (SCN)	4, 5	P
	Sierran Mixed Conifer (SMC) – Fir dominated stands only	4	M, D
	Sierran Mixed Conifer (SMC) – Pine dominated stands only	5, 6	M, D

Within the Sagehen Wildlife analysis area, there is a total of 29,467 acres of which 75% (22,237 ac) is on National Forest System lands (NFS) and 25% (7,230 ac) is in private ownership. Of the total National Forest System lands in the analysis area, 14% is high quality marten habitat; 9% is moderate quality marten habitat; and 76% is not suitable.

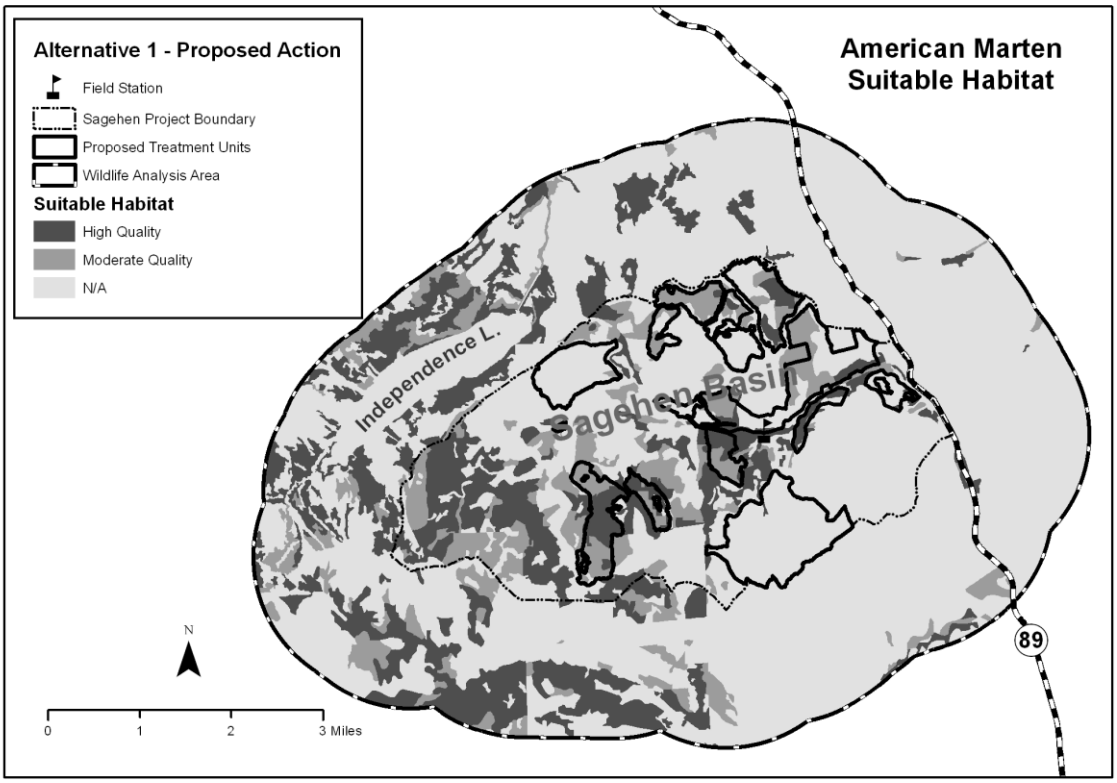


Figure 3.8 depicts a map of Pacific marten high and moderate quality habitat including proposed treatments for the proposed action. Figure 3.8. Pacific marten high and moderate quality habitat within the analysis area.

Direct and Indirect Effects

Assumptions used for the analysis:

- Pacific marten habitat is generally associated with mature forests (mid to late-successional forests)
- Martens are sensitive to the loss and fragmentation of mature forest habitat
- Marten habitat is important to consider at the local scale, home range scale, and landscape scale
- High quality marten habitat dominated by large trees, moderate to high canopy cover, abundance of snags and downed logs provide prey resources, resting structures, and escape cover to avoid predators.
- Martens can inhabit younger or managed forests as long as some of the structural elements found in older forests remain, particularly those required for resting and denning
- Forest management aimed at promoting forest resiliency and patch-scale heterogeneity can meet fuels and ecological restoration objectives and provide for marten habitat (North et al. 2009, North et al. 2012)
- Forest management and fuels reduction strategies using slope, topographic position and aspect that would result under a natural disturbance regime may benefit marten by reducing

the risk of stand-replacement wildfires, although short-term impacts to habitat would be expected while still providing sufficient marten habitat

Direct Effects – Project Disturbance

Pacific marten inhabiting the Sagehen Basin has the potential to be directly disturbed by project activities under both Alternatives 1 and 3. Disturbance from proposed treatments could result in displacement and/or mortality to marten, or short-term changes in behavior or stress levels. Alternative 1 would have the greatest potential to disturb marten, since mechanical methods would be used and would likely create the most noise related disturbance. Alternative 3 would result in less marten disturbance compared to Alternative 1, since all treatments are hand treatments and would result in fewer acres potentially causing disturbance to the marten. Alternative 2, No Action, would not result in direct effects or disturbance to marten.

Indirect Effects - Habitat Quantity and Quality

Forest Thinning

The largest potential threat to marten and their habitat is the effect of forest thinning, since clear-cutting is virtually non-existent on public lands. However, harvesting on private land may still have significant effects to marten habitat availability. The effects of forest fragmentation has been reported in numerous cases in the literature, mainly describing the sensitivity of martens to the effects of forest fragmentation (Bissonette et al. 1997, Chapin et al. 1998, Hargis et al. 1999, Potvin et al. 2000 in Zielinski 2013), but in these cases, the fragmentation is typically due to regeneration or clear-cut harvests. How thinning treatments fragment habitat is poorly known, but it is under study in the Cascades in California (K. Slauson, unpubl. data; K. Moriarty, unpubl. data). Fuller and Harrison (2005) evaluated the effects of partial harvests on martens in Maine. They found martens used the partial harvest stands primarily during the summer, where 52-59 percent of the basal area was removed in partial harvests. Marten home ranges were larger when they used partial harvest stands, indicating poorer habitat quality in these areas. Partial harvested areas were avoided during the winter, presumably because they provided less overhead cover and protection from predators. How this study relates to predicting the effects of thinning in marten habitat in the Sierra Nevada is unclear, but it may suggest that martens would likely be associated with the more dense residual areas in thinned units and may also increase their home ranges, which may lead to decreased population density. The negative effects of thinning likely result from reducing overhead cover. Thinnings from below, which retain overstory cover, probably have the least impact on marten habitat, provided they retain sufficient ground cover. Downed woody debris provides important foraging habitat for martens. Andruskiw et al. (2008) found that physical complexity on or near the forest floor, which is typically provided by coarse woody debris, is directly related to predation success for martens; when this complexity is reduced by timber harvest (a combination of clear-cut and selection harvests with subsequent site preparation in their study area), predation success declines. Marten home ranges in uncut forests had 30 percent more coarse woody debris (> 10 cm diameter) from all decay classes combined than in cut forests (Andruskiw et al. 2008).

As stated above, indirect effects to marten abundance and distribution can be affected by habitat alteration from thinning and fuels treatment activities that affect canopy cover density, forest structure, understory condition, and availability of large trees. The availability of snags and down logs is also important to consider within marten and their prey species habitats. The indirect effects of the project alternatives to high and moderate quality marten habitat will be described within the Sagehen Project wildlife analysis area encompassing 29,467 acres. The metrics or considerations for analyzing indirect effects are as follows:

- Changes to CWHR Type, Size Class, and Canopy Cover
- Snags and Downed Log Abundance
- Habitat Fragmentation and Structural Diversity
- Forest
- Resiliency

Suitable high and moderate quality marten habitat were assessed for potential effects of proposed treatments for the action alternatives, Table 3.17 below. Of 2,536 acres proposed for thinning, a total 775 acres of suitable high and moderate quality habitat (232 acres – high quality, 544 acres - moderate quality) are proposed for treatment under Alternative 1. Out of 232 acres of high quality marten habitat, thinning and fuels treatments (including variable thinning, legacy tree treatments, and suppressed cutting) 133 acres of CWHR 4D would change to 4M (5D to 5M, unit 213 only), where canopy cover would be reduced below 60%. Approximately 59 acres would remain in the CWHR 4D/5M type post-treatment, and 40 acres would remain as CWHR 4M. While a short-term reduction in canopy cover would result from proposed treatments, all 232 acres would remain as high quality habitat immediately following treatments, but would result in reduced in quality in the short-term.

Of the 544 acres of moderate quality marten habitat proposed for treatment, 407 acres would change from CWHR 4D to CWHR 4M, 87 acres would remain CWHR 4M, 42 acres would change from CWHR 4D to 4P, and 8 acres would remain as CWHR 4P types post-treatment. The 42 acres that would change from CWHR 4D to 4P where post-treatment canopy cover level would fall below 40% are located within Unit 33. However, the residual canopy cover for Unit 33 would be above 40%, and therefore, Forest Plan standards and guidelines to retain suitable marten habitat >40% canopy cover would be met. Current unit average canopy cover ranges from 51% to 80% and post-treatment average canopy cover would range from 41% to 71% under Alternative 1.

Under Alternative 3, Non-commercial Alternative, a subset of Alternative 1 units (1,137 acres) would be proposed for treatment to meet fuels objectives, where 222 acres of high and moderate quality habitat (146 acres – high quality, 76 acres – moderate quality) would result in lowered canopy cover in the short term. All 222 acres of suitable marten habitat would remain suitable, but habitat quality would be lowered in the short-term. Approximately 68 acres of nesting habitat would change in CWHR type 4D to 4M, 58 acres would remain as CWHR 4D, and 21 acres would remain as CWHR 4M following treatments. The quantity of suitable high quality marten habitat would remain unchanged following hand thinning treatments and follow-up fuels treatments such as, prescribed fire and mastication where treatment involves removal of small diameter trees that would not result in a

significant change in canopy cover or tree class. Proposed treatments of moderate quality habitat would change from CWHR 4D to CWHR 4M on 21 acres, remain as CWHR 4D on 41 acres, remain as CWHR 4M on 10 acres, and 4 acres would stay as CWHR 4P post-treatment.

Under Alternative 3, the opportunity to increase and enhance forest resiliency and structure diversity would not be achieved on approximately 1,399 acres that are proposed for treatment under Alternative 1. Legacy tree treatments and decadent feature enhancements that would enhance and increase course woody debris important for marten denning and resting would not be realized. Enhancing marten prey habitat by creating landscape level heterogeneity from early seral openings and decadent feature enhancements on 1,399 acres would not occur in mechanical thinning units. The average unit canopy cover for Alternative 3 currently ranges from 51% to 76%. Average canopy cover for the units following treatments would range from 41% to 71%.

Under Alternative 2, No Action, 2,563 acres, including 775 acres of high and moderate quality marten habitat would not be treated and therefore, canopy cover would not change or be reduced in quality. However, forest resiliency, forest structural diversity, and reduced fuels hazard would not be realized under the No Action Alternative. Stand density reduction would not occur and therefore, legacy tree treatments that would promote the growth and protection of large, old trees important for marten denning, resting, and foraging would not be achieved in the long-term. In the long-term, marten denning and foraging habitat throughout the Sagehen Basin would remain at a higher risk of severe wildfire effects under the No Action Alternative.

Table 3.17. Current and Post-Treatment CWHR Habitat Acres within High and Moderate Quality Marten Habitat by Unit									
Alternative 1									
Unit	Unit Acres	High Quality Marten Habitat			Moderate Quality Marten Habitat			Unit Average Canopy Cover	
		Acres	Current CWHR type, size, Canopy Cover Class	Post-treatment CWHR type, size, Canopy Cover Class	Acres	Current Tree Size and Canopy Cover Class	Post-treatment Tree Size and Canopy Cover Class	Current Canopy Cover	Post-Treatment Canopy Cover
33	118	4	RFR4D	RFR4M	37	SMC4D	SMC4M	71%	44%
					32	SMC4D	SMC4P		
34	68	0	None	None	33	SMC4D	SMC4M	70%	53%
					1	SMC4M	SMC4M		
35	64	6	LPN4D	LPN4M	15	SMC4D	SMC4M	68%	47%
					6	SMC4M	SMC4M		
36	101	0	None	None	0	None	None	75%	50%
38	210	31	WFR4D	WFR4M	47	SMC4D	SMC4M	63%	52%
		19	WFR4M	WFR4M					
46	621	0.4	LPN4D	LPN4M	0	None	None	51%	41%
		4	(RFR, LPN) 4M	(RFR, LPN)4M					
47	33	0	None	None	0	None	None	51%	46%
61	20	20	(LPN,WFR) 4D	(LPN,WFR) 4D	0	None	None	74%	64%

73	144	0	None	None	66	SMC4D	SMC4M	72%	51%
					21	SMC4M	SMC4M		
76	91	0.1	LPN4D	LPN4M	2	SMC4D	SMC4M	56%	43%
80	5	0	None	None	5	SMC4D	Aspen 4M	>60%	40-60%
85	64	0	None	None	5	SMC4D	SMC4M	62%	56%
87	206	0	None	None	0	None	None	60%	46%
89	34	0	None	None	2	SMC4D	SMC4M	80%	56%
90	40	0.10	LPN4D	LPN4M	31	SMC4D	LPN4M	78%	51%
					4	SMC4M	SMC4M		
91	9	6	LPN4D	LPN4M	1	SMC4D	SMC4M	62%	58%
		1.5	LPN4M	LPN4M					
98	63	45	LPN4D	LPN4M	0	None	None	59%	40%
99	67	11	LPN4D	LPN4D	0.6	LPN4P	LPN4P	59%	63%
100	120	27	LPN4D	LPN4D	41	SMC4D	SMC4D	64%	60%
					10	SMC4M	SMC4M		
					3.5	LPN4P	LPN4P		
163	82	24	(LPN, WFR) 4D	(LPN, WFR) 4M	39	SMC4D	SMC4M	66%	50%
					13	SMC4M	SMC4M		
					4	LPN4P	LPN4P		

213	268	1	SMC5D	SMC5D	111	(LPN, WFR, RFR) 4D	(LPN, WFR, RFR) 4M	68%	55%
		0.05	SMC5D	SMC5M	1	(LPN, WFR, RFR) 4M	(LPN, WFR, RFR) 4M		
282	108	16	LPN4D	LPN4M	13	SMC4D	SMC4D	76%	59%
		15	LPN4M	LPN4M					
Totals	**2,536**	**231**			**544**				

Alternative 3*

Unit	Unit Acres	High Quality Marten Habitat			Moderate Quality Marten Habitat			Unit Average Canopy Cover	
		Acres	Current CWHR Type, Size, and Canopy Cover Class	Post-treatment CWHR Type, Size, and Canopy Cover Class	Acres	Current Tree Size and Canopy Cover Class	Post-treatment Tree Size and Canopy Cover Class	Current Canopy Cover	Post-Treatment Canopy Cover
46	621	0.4	LPN4D	LPN4M	0	None	None	51%	41%
		4	(RFR, LPN)4M	(RFR, LPN)4M					
47	33	0	None	None	0	None	None	51%	47%
61	20	20	(LPN,WFR)4D	(LPN,WFR)4D	0	None	None	74%	64%
76	91	0.1	LPN4D	LPN4M	2	SMC4D	SMC4M	56%	43%
80	5	0	None	None	5	SMC4D	ASPEN4M	>60%	40-60%
91	9	6	LPN4D	LPN4M	1	SMC4D	SMC4M	62%	58%

		1.5	LPN4M	LPN4M					
98	63	45	LPN4D	LPN4M	0	None	None	59%	40%
99	67	11	LPN4D	LPN4D	0.6	LPN4P	LPN4P	59%	63%
100	120	27	LPN4D	LPN4D	41	SMC4D	SMC4D	64%	60%
					10	SMC4M	SMC4M		
					3.5	LPN4P	LPN4P		
282	108	16	LPN4D	LPN4M	13	SMC4D	SMC4D	76%	59%
		15	LPN4M	LPN4M					
Totals	**1,137**	**146**			**76**				
Alternative 3* - No treatment in Units 33, 34, 35, 36, 38, 39, 73,85, 87, 156, 163, 213									

Dense Cover Areas (DCAs) and Early Seral Openings (ESOs) in Suitable Marten Habitat

DCAs are areas that are delineated within treatment areas that will remain intact and provide high to moderate quality marten habitat which typically provide areas of higher canopy cover and larger trees compared to the surrounding areas. Alternative 1 proposes to delineate a total of 78 acres of DCAs, of which 15 acres are not suitable, 28 acres are high quality, and 36 acres are moderate quality habitat for the marten.

Alternative 1 proposes to create a total of 54 acres of ESOs, of which 15 acres are not suitable, 11 acres are high quality, and 29 acres are moderate quality marten habitat. Emphasis areas 1 and 2 represent areas that currently have higher amounts of high and moderate quality marten habitat. Approximately 13 acres of ESO's are proposed within emphasis area 1. No ESOs are proposed within emphasis areas 2 or 4 that occur along the drainage bottoms. These ESOs are roughly ¼ to ½ acre in size and would be scattered throughout these emphasis area 1. The ESOs would result in removal of all existing trees and would eventually be planted or naturally regenerate over time. Therefore, the CWHR vegetation class in ESOs would likely remain the same as the current existing vegetation following treatment. However, the CWHR tree size and canopy classes would be reverted to early seral openings following treatments, as all trees would be removed. Moreover, it is expected that the ESOs would eventually become forested and not result in long-term type conversion. Additionally, the ESOs would not alter or change the

marten habitat suitability across the treatment units or would not result in habitat fragmentation at the landscape level, particularly since small localized openings would not increase the distance between suitable habitat patches. In the Rocky Mountains, the average width of clear cuts (openings) crossed by martens was 460 ft; this distance is significantly greater than the size of early seral openings proposed for the Sagehen Project.

Both Alternatives 1 and 3 would designate a total of 28 acres of DCAs within fuels treatment (units 61, 91, 98, 99, 100, 282). Out of 573 acres of fuels treatment acres in these units, 134 acres (23%) are high quality marten habitat and 70 acres (12%) are moderate quality marten habitat. It can be assumed that the DCAs represent a relatively similar proportion of denning and foraging habitat within the fuels treatment units, since specific habitat data for DCAs within fuels treatment units was not available for this analysis. Under Alternative 3, increased structural diversity from DCAs would only occur across 1,132 fuels treatment acres compared to the 1,664 acres in Alternative 1 (Units 33, 34, 35, 36, 38, 61, 73, 85, 89, 90, 91, 156, 163, 213, and 282) where the combination of DCAs and ESOs would contribute to more resilient forests and heterogeneity across the landscape. Alternative 2 would provide no change in forest structural diversity across the landscape, but would have the least impacts to marten habitat in the short-term since no ESOs would be created where all the trees would be harvested.

Snags and Down Logs

Snags and down logs were analyzed in the section *Effects Common to All Wildlife*. Generally, Alternative 1 would maintain all existing snags >15 inch dbh, except for those needing to be removed for equipment operability or those that pose a risk public safety. It is expected that there would be no measurable difference in the number of snags greater than 15 inches dbh between the existing condition and the immediate post treatment condition.

The Forest Vegetation Simulator model projected that Alternative 1 would result in lower snag abundance compared to Alternatives 2 and 3 within 30 and 50 years after treatment. Generally, Alternative 2 would result in the most snags compared to Alternatives 1 and 3, 30 and 50 years post-treatment. In all cases, the snag densities projected at 30 and 50 years post-treatment would retain snag densities per Forest Plan standards and guidelines throughout the Sagehen Basin under all the alternatives. Under Alternative 2, the opportunity to create denning habitat structures from decadent feature enhancements (creating short snags and partial tree girdling) would not occur on 2,563 acres, including 775 acres of suitable marten habitat.

Habitat Fragmentation and Connectivity

Several studies on marten suggest that marten are extremely sensitive to habitat fragmentation. Habitat Fragmentation to the marten should be addressed at three spatial scales: 1) local site, 2) home range, and 3) landscape scale. Within the 29,467-acre analysis area, approximately

24% is high and moderate quality marten habitat (Moriarity, as modified), with the remaining 76% is either not suitable or only marginally suitable.

The Sagehen Project was specifically designed for wildlife habitat enhancement, particularly for the marten as well as other mature and late-seral associated species, such as the goshawk and the spotted owl. Proposed forest thinning and fuels treatments under Alternatives 1 and 3 are not expected to increase or contribute to marten habitat fragmentation as there would be no reduction or removal of high and moderate quality habitat, although there would be short-term reduction in habitat quality on 775 acres of suitable habitat affecting both overstory and understory components. Alternative 3 would affect fewer habitat acres than Alternative 1. Desired canopy cover, large tree distribution, and coarse wood would be maintained throughout the project units and within suitable marten habitat.

Early seral openings would not fragment habitat as they are small (0.25 and 0.5 acres) and would not restrict marten movement. Openings would be scattered throughout proposed treatment units under Alternative 1 and would not compromise suitable habitat capability for the marten (none in Alternative 3). Individual openings would likely enhance marten prey base through increased forage production. These openings would also contribute to forest structural diversity and heterogeneity.

The maintenance and enhancement of large and old trees that are important to marten would be provided throughout treatment units. In a similar fashion, coarse woody debris (logs and snags) would be maintained as well as enhanced through the development and creation of short snags and partial tree girdling.

The Sagehen Basin is within the Tahoe NF Forest Carnivore Network, which was developed to provide connectivity for Forest Carnivores at the landscape level. The Carnivore Network was modeled using suitable habitat criteria for the marten and was based on the home range of the marten. As such, connectivity within the Carnivore Network would be maintained throughout the Basin, within the greater 29,467 acre-analysis area, and within the Carnivore Network.

Changes in Marten Habitat

The maps shown in Figure 10 and 11 display the amount and distribution of high, moderate, and low quality marten habitat for existing and immediately post-treatment within the Basin. There are a total of 3,679 acres of existing high and moderate quality marten habitat and 3,595 acres immediately post-treatment. The reduction of high quality habitat is primarily attributed to treatments that would move to moderate quality habitat or moderate quality moving into low quality habitat in the short-term. Habitat that moves into the low quality habitat classification falls within portions of certain units where canopy cover dropped slightly below 40% (not across the entire unit). For example, canopy cover would change from 56% to 38% within emphasis area 6 of Unit 33. However, the weighted unit average canopy cover would be

44% across the entire 118 acres within Unit 33 (See Silviculture Report, Table 16, p. 78), and therefore, the resulting CWHR type would be 4M or moderate quality for that entire unit.

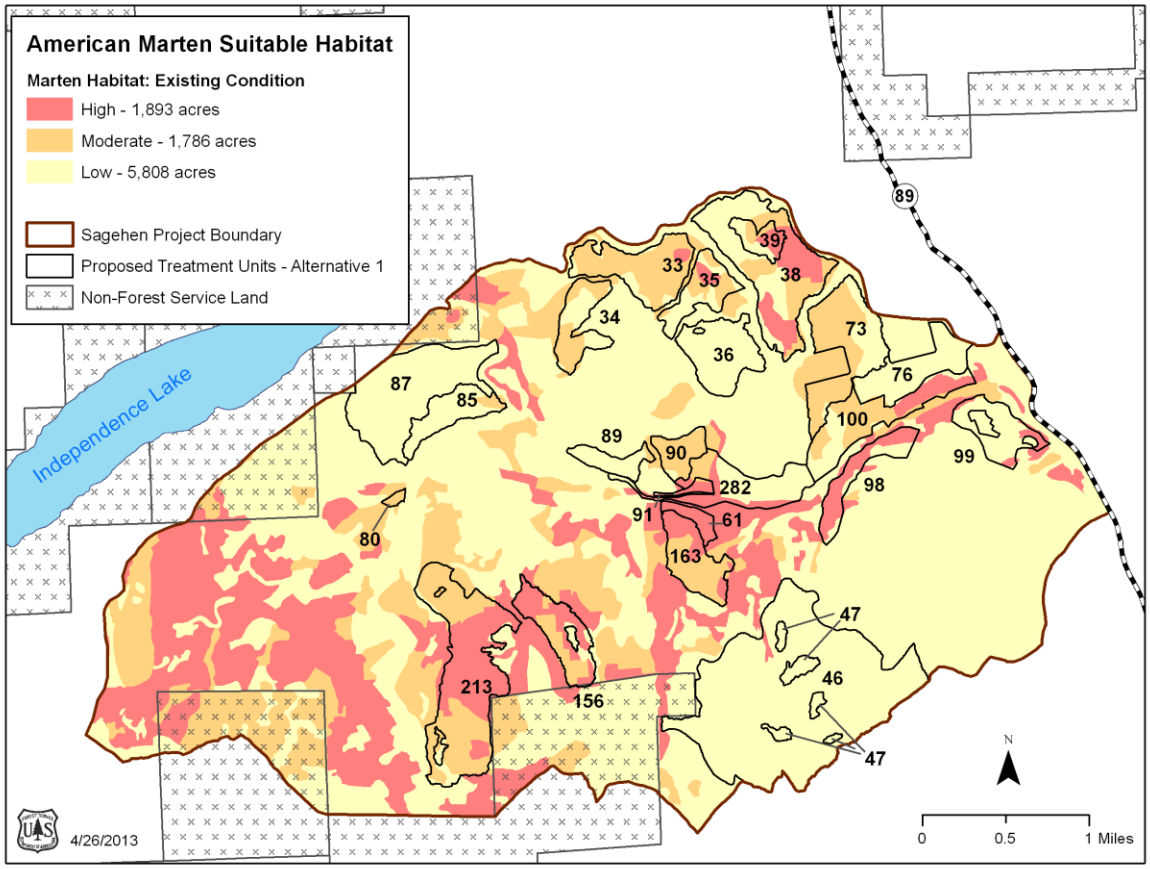


Figure 10. Existing Marten Habitat within Sagehen Basin

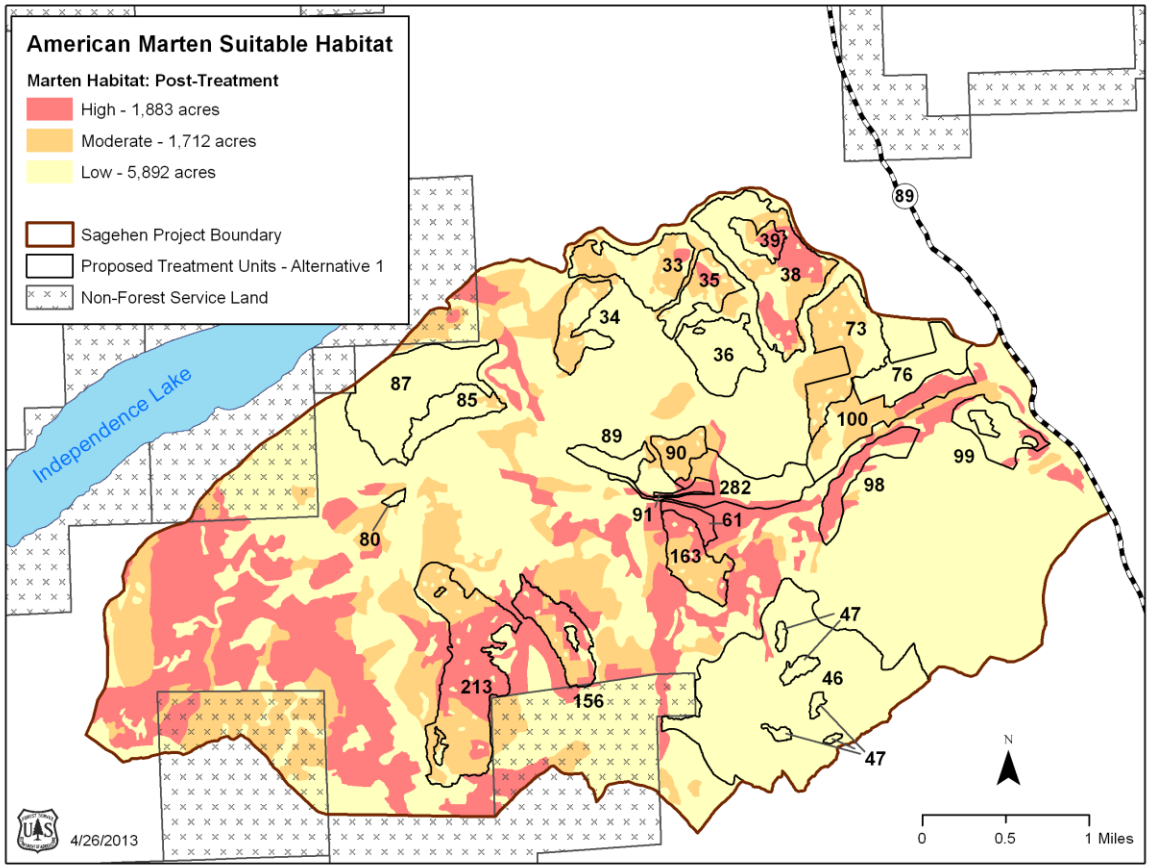


Figure 11. Post-Treatment Marten Habitat within Sagehen Basin

Table 41 below shows the changes to existing habitat marten habitat within proposed treatment units for Alternative 1, immediately post-treatment and 30 years after treatment. Initially, high quality habitat changes from 433 acres to 423 acres, but increases to 521 acres 30 years later, indicating an overall increase of 88 acres of high quality habitat compared to existing conditions. A similar trend follows for moderate quality habitat where 650 acres of moderate quality habitat is reduced to 576 acres initially, but increases to 615 acres 30 years after treatment. After 30 years, high quality habitat, important for marten denning, increases by a net of 88 acres.

Table 41. Acres of Marten Habitat within Treatment Units for Existing Condition, Post-Treatment, and 30 Years Post-Treatment (Alternative 1)

Marten Habitat Quality	Existing (Acres)	Post-Treatment (Acres)	30 Years Post-Treatment (Acres)	Net Change 30 Years Post-treatment (Acres)
High	433	423	521	+88
Moderate	650	576	615	-35
Low	1,568	1,653	1,515	-53

The next three maps (Figure 12, 13, 14) display the distribution and amount of marten habitat within the treatment units for existing conditions, immediately post-treatment, and 30 years after treatment.

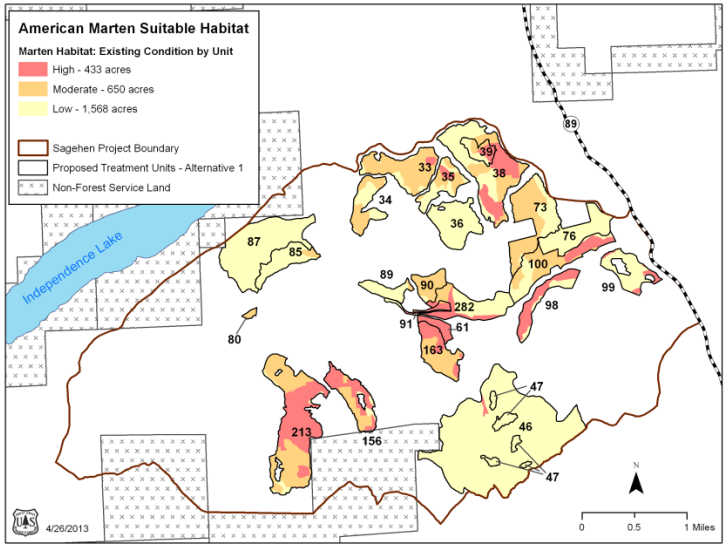


Figure 12. Existing Marten Habitat by Unit

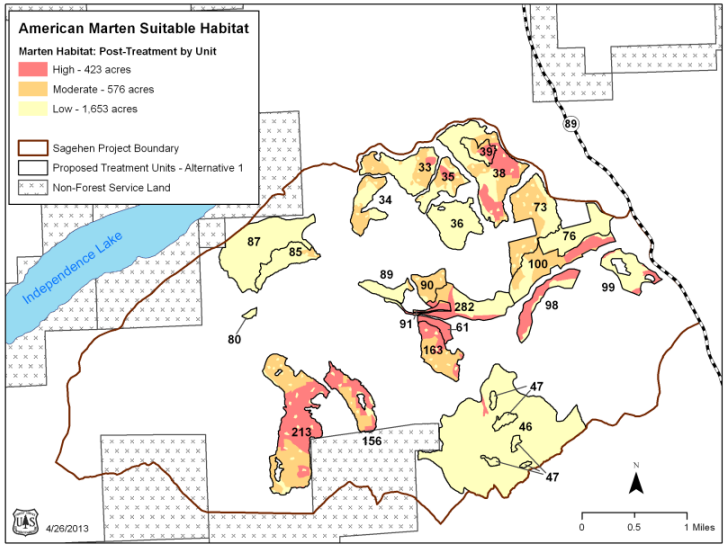


Figure 13. Marten Habitat Post-treatment by Unit

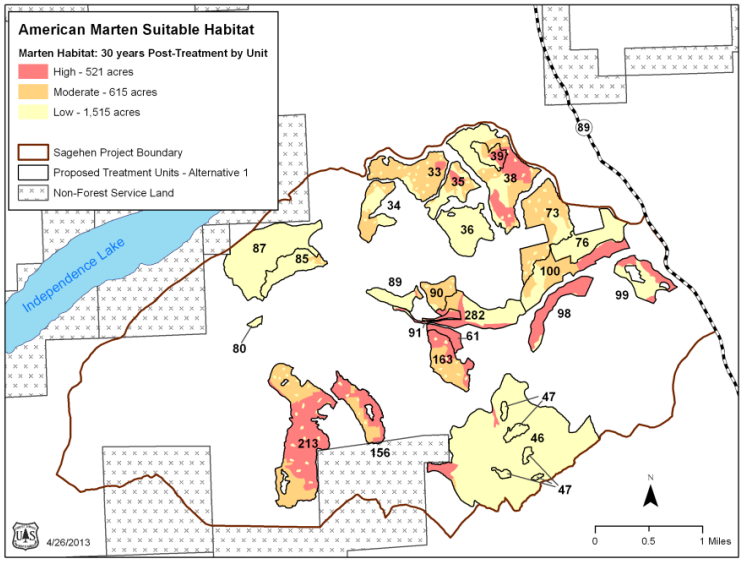


Figure 14. Marten Habitat 30 Years Post-treatment by Unit

FRAGSTAT Analysis for Marten Habitat

An analysis of marten habitat using FRAGSTATS v4: Spatial Pattern Analysis Program for Categorical and Continuous Maps (McGarigal et al. 2012) was conducted to spatially and quantitatively assess the distribution, amount and configuration of suitable marten habitat throughout the Sagehen Basin through time. This analysis addresses marten habitat in terms of patch size, patch distribution, and distance between patches.

For the analysis, existing high and moderate quality marten habitat was analyzed immediately post-treatment and 30 years post-treatment. However, there are caveats and limitations that must be considered when reviewing the results of the FRAGSTAT model. Therefore, when interpreting the results of the FRAGSTAT analysis, it is important to understand that modeling has limitations and that the results must be viewed with caution.

- The FVS model has limited applicability for predicting distribution of post-treatment CWHR types, since the FVS model outputs are not spatially explicit. The average stand conditions generated from the FVS model are then used to estimate CWHR classification types. Using unknown accuracy and then running through a FRAGSTAT model further introduces uncertainty and limitations of the modeling results.

- Attempting to project vegetation changes into the future introduces uncertainty because there are not any spatially explicit growth models available. For the areas outside of units, the VDDT model was used to project vegetation 30 years beyond the present time. VDDT tool also is not a spatially explicit model. Therefore, interpretation of the VDDT vegetation changes, and then translating and applying it to a spatially explicit model, such as FRAGSTAT further introduces uncertainty.

FRAGSTAT Analysis Results:

The risk to marten habitat fragmentation was analyzed, in both in the short- and long-term, using FRAGSTAT (Version 4) (McGarigal et al. 2012) modeling (to estimate patch size, patch distribution, and distance between patches of high and moderate marten habitat within the Sagehen Basin, in a similar way that Moriarity et al. (2011) assessed marten habitat fragmentation within the Basin. A detailed description of FRAGSTAT marten habitat analysis is presented in Appendix A of the BE. Existing high and moderate quality marten habitat was analyzed immediately post-treatment and 30 years post-treatment to assess effects from treatments on potential marten habitat fragmentation. In summary, the FRAGSTAT modeling results indicate that marten habitat connectivity would be maintained following the treatments and 30 years into the future. Key results from the FRAGSTAT modeling include the following:

- High quality habitat only decreased by 0.1% across the landscape immediately post-treatment and increased to by an additional 0.5% 30 years after treatment.
- The large patches of habitat remained constant across the landscape both following treatment and 30 years into the future.
- The percentage of core area decreased from 4.12% to 3.4% initially after treatment and was predicted to increase to 4.9% 30 years after treatment.
- The distance to the nearest patch increased slightly immediately following treatment, but decreased to less than existing patch distance 30 years later. The distribution of patches changed very little. Additionally, proximity of high quality patches to one another improved both post-treatment and 30 years into the future.

Marten habitat modeling using the FRAGSTAT program is depicted in the three marten habitat maps (Figures 15, 16, 17) for existing condition, immediately post-treatment, and 30 years after treatment. Overall habitat connectivity is achieved in both the short and long-term. High quality habitat patches decreases slightly immediately post-treatment, but high quality habitat patches recovers after 30 years. Patch size, configuration and distances between patches remains consistent, except for a small portion of moderate quality habitat where canopy cover drops slightly below 40% within unit 33 for Alternative 1. None of the areas would prohibit movement or create long-term fragmentation at the landscape scale.

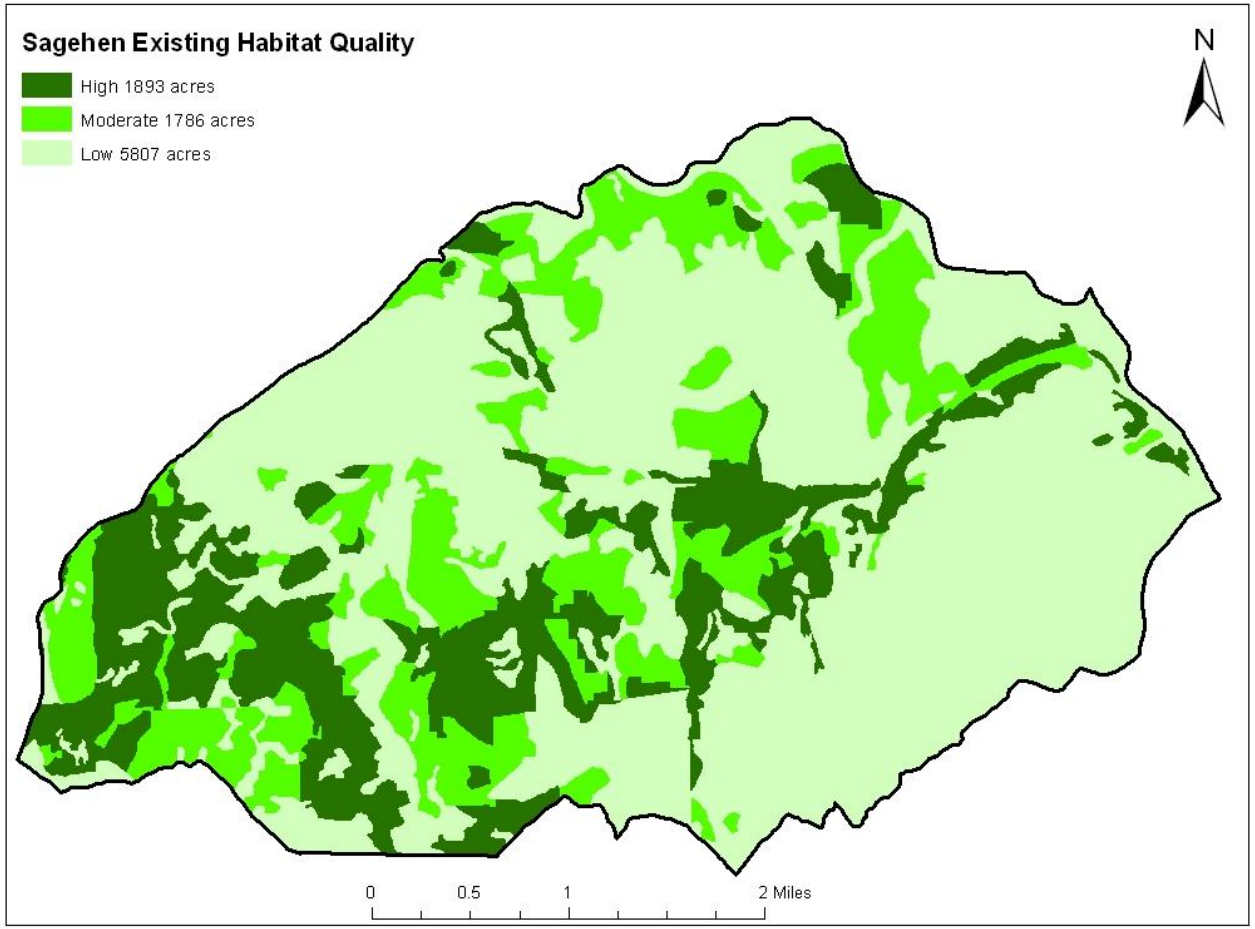


Figure 15. Existing marten habitat as classified by high, moderate, and low quality types.

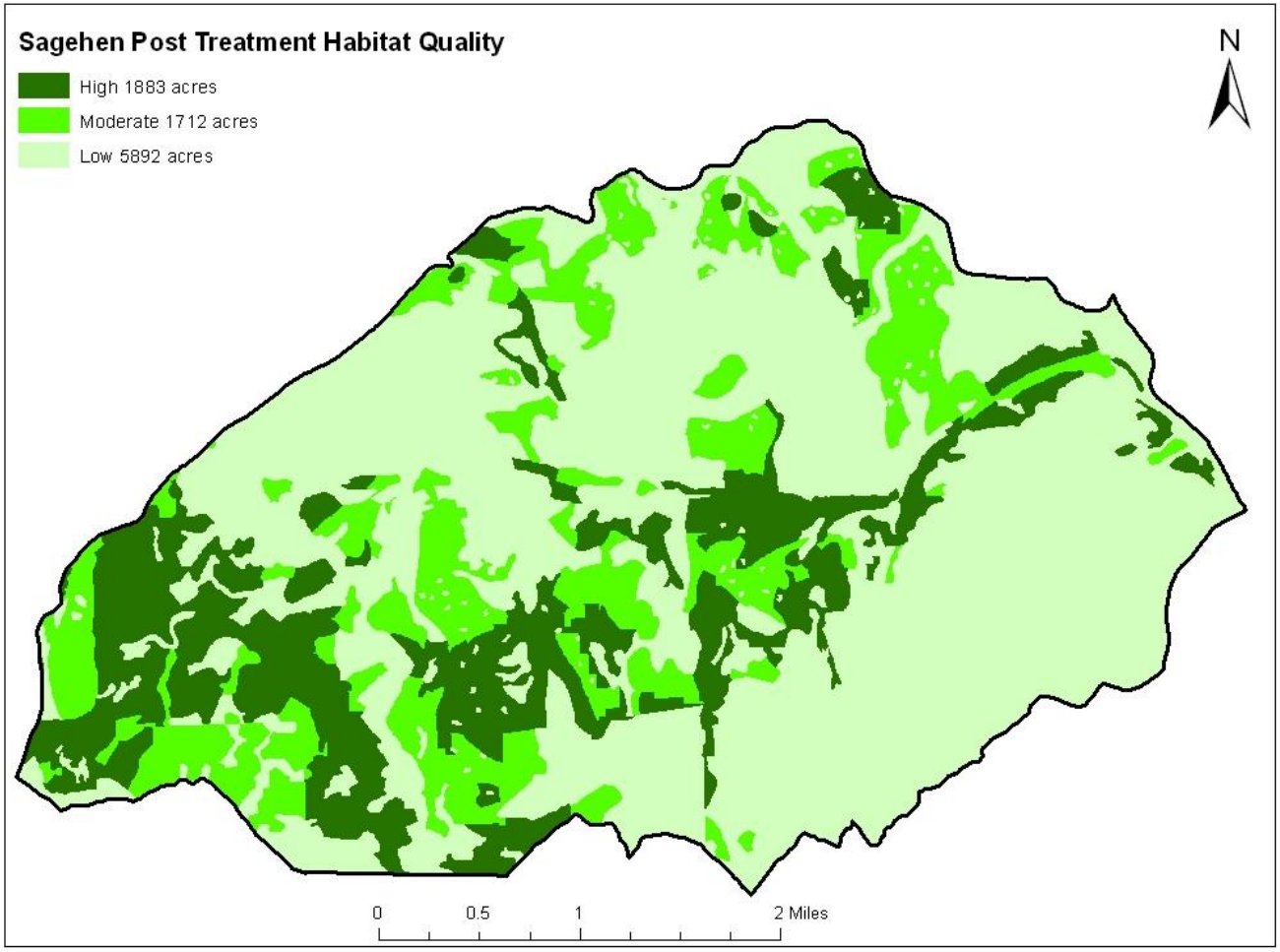


Figure 16. Post-treatment marten habitat as classified by high, moderate, and low quality types.

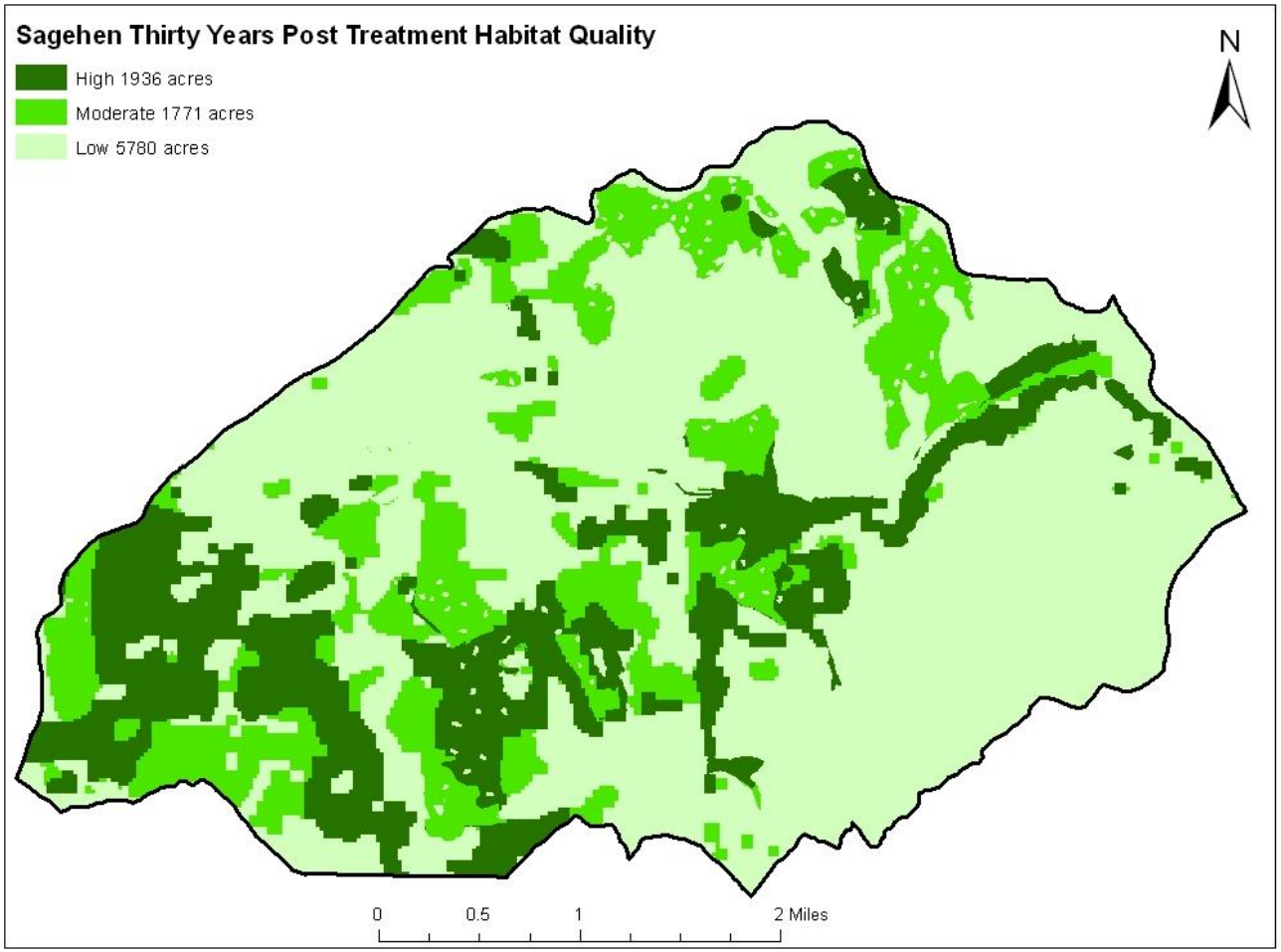


Figure 17. Thirty year post-treatment marten habitat as classified by high, moderate, and low quality type

Conclusion and Determination

The Sagehen Project uses concepts from GTR-220 and GTR-237 which strives to promote long-term ecosystem restoration, forest resiliency, and fuels reduction while using innovative vegetation treatments that enhances and retains suitable goshawk habitat across the analysis area. The Sagehen Project, as proposed, would:

- Maintain high and moderate quality marten habitat within throughout the treatment units in the long-term. Treatments as proposed under Alternatives 1 and 3 would result in the short-term reduction in marten habitat quality on 775 acres while promoting long-term sustainability and resiliency of habitat by treatments specifically designed to improve marten habitat such as, legacy tree treatment, fuels reduction, increased horizontal and vertical structural diversity, and decadent feature enhancements.
- Retain high and moderate quality marten habitat dominated by large trees, moderate to high canopy cover, abundance of snags and downed logs, and therefore promote marten persistence and reproductive success.
- Maintain and create habitat for marten prey species, particularly, birds and small mammals through various treatments, including dense cover areas , early seral openings, snag creation, and retention of shrubs.
- Promote forest resiliency and patch-scale heterogeneity to meet fuels and ecological restoration objectives while enhancing and maintaining marten habitat in the long-term.
- Forest management and fuels reduction strategies uses slope, topographic position and aspect that would result under a natural disturbance regime may benefit marten and its habitat, while undergoing short-term impacts.

Implementation of Alternatives 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the Pacific marten as discussed previously in this evaluation, and professional judgment.

CALIFORNIA WOLVERINE

Status: USFS R5 Sensitive, USFWS Proposed

The wolverine is a California State Threatened species, and is listed on the USFS Regional Forester's Sensitive Species list. The wolverine has been petitioned for listing as threatened or endangered under the Endangered Species Act, but upon status review in 2008 the USFWS determined it was not warranted listing (USDI Fish and Wildlife Service 2008; 73 FR 12929). On July 8, 2008 FWS received a Notice of Intent to Sue from Earthjustice alleging violations of the Act in their March 11, 2008, 12-month finding. On September 30, 2008, Earthjustice filed a complaint in the U.S. District Court, District of Montana, seeking to set aside and remand the 12-month finding back to the Service for reconsideration. On March 6, 2009, the Service agreed to settle the case with Earthjustice by voluntarily remanding the 12-month finding and issuing a new 12-month finding by December 1, 2010. Following the settlement agreement, the court dismissed the case on June 15, 2009, and ordered the Service to comply with the settlement agreement. On April 15, 2010, the Service published a Notice of Initiation of a 12-month

finding for wolverines in the contiguous United States (75 FR 19591). That finding was published on December 14, 2010, and determined that the wolverine in the contiguous United States constituted a Distinct Population Segment and that the DPS warranted listing under the Act, but that listing was precluded by higher priority listing actions (75 FR 78030).

On February 4, 2013, The U.S. Fish and Wildlife Service published a proposed rule to list the distinct population segment of the North American wolverine occurring in the contiguous United States, as a threatened species under the Endangered Species Act (USDI Fish and Wildlife Service 2013; [FWS–R6–ES–2012–0107: 4500030113]. FWS also proposes a special rule under section 4(d) of the Act to apply the specific prohibitions of the Act necessary to protect the wolverine. The FWS has determined that habitat loss due to increasing temperatures and reduced late spring snowpack due to climate change is likely to have a significant negative population-level impact on wolverine populations in the contiguous United States. In the future, wolverine habitat is likely to be reduced to the point that the wolverine in the contiguous United States is in danger of extinction.

The wolverine occurs at low densities and is secretive, difficult to observe even in core areas of its range, and one of the rarest and least known mammals in North America (Aubry et al. 2007). Zielinski et al. (2005), based on the lack of detections of wolverine in contemporary surveys, noted that the California wolverine may be extirpated or in extremely low densities from the southern Cascades through the Sierra Nevada. Since the last historic specimen was collected in California in 1922 (Fry 1923, and Grinnell et al. 1937 as cited in Aubry et al. 2007), there have been periodic anecdotal sightings (lacking conclusive physical evidence) of the wolverine in California including many in Tahoe National Forest, though these anecdotal sightings should be interpreted with caution (refer to McKelvey et al. 2008). In 2008, photographs and DNA were collected which verified the presence of a single male wolverine on the east side of Tahoe National Forest (Moriarty et al. 2009). Genetic analysis of this individual compared with wolverines across their range, including the seven genetic samples from California wolverine museum specimens (Schwartz et al. 2007), supports that the origin of this individual is from the western edge of the Rocky Mountains region, possibly from the Sawtooth Mountain Range in Idaho (Moriarty et al. 2009). Additional photographs of this individual (confirmed with DNA analysis) have been collected since that time on land owned by Sierra Pacific Industries (SPI) in the checkerboard ownership area in the northern portion of Tahoe National Forest (SPI, unpublished data on file at Tahoe National Forest, Supervisor's Office).

The historic geographical range of the wolverine in California was originally described from the vicinity of Mount Shasta to Monache Meadows in Tulare County (Grinnell 1913 as cited in Shempf and White 1977), which was later refined to Lake Tahoe through Tulare County in the central and southern Sierra Nevada (Grinnell 1933 and Grinnell et al. 1937, as cited in Shempf and White 1977). Fry (1923) noted that the wolverine was found in the high Sierra between 6,500 and 13,000 feet, that it was becoming very rare with individuals few and scattered where still found, and were most abundant in the vicinity of Mt. Whitney and Sequoia National Park. Grinnell et al. (1937) noted that "the wolverine in California is found chiefly in the Boreal life zone...at the time of heavy snowstorms in midwinter, wolverines have been found as low as 5,000 feet on the westslope of the Sierra Nevada...But ordinarily the wolverine is not known to come below 8,000 feet, even in the severest storms of winter." Grinnell et al. (1937)

estimated that there were no more than 15 pairs of wolverines left in California in the early 1930s. Based on reported sightings from various sources, Schempf and White (1977) described the wolverine distribution in California as a broad arc from Del Norte and Trinity counties (Yocum 1973) east through Siskiyou and Shasta Counties (Wildlife Management Institute 1974 as cited in Schempf and White 1977), and south through the Sierra Nevada to Tulare County (Jones 1950 and 1955). Kovach (1981) expanded this range to include the White Mountains in Mono County. Shempf and White (1977) described the elevational range in the North Coast mountains from 1,600 to 4,800 ft, in the northern Sierra Nevada from 4,300 to 7,300 ft, and in the southern Sierra Nevada from 6,400 to 10,800 ft. However, Aubry et al. (2007) scrutinized the historical records, and suggest that historically the wolverine population in the Pacific states was disjunct, with a large gap in distribution from the populations in the north Cascades and the Rocky Mountains to the historic California wolverine population, which only occurred in the central and southern Sierra Nevada. This conclusion is reinforced by genetic analysis conducted by Schwartz et al. (2007). Schwartz et al. (2007) compared DNA from seven historical specimens of wolverines from California with those from other locations throughout their holarctic distribution; their results indicate that wolverines from California likely genetically diverged over 2,000 years (and possibly much longer) ago from any other population, and are genetically more similar to Eurasian wolverines than to other North American populations.

Wolverine habitat relationships, particularly in the contiguous lower 48 States, are not well-studied (Ruggiero et al. 2007, Aubry et al. 2007, Copeland et al. 2007). Empirical data from peer-reviewed literature on habitat relations, home-range sizes, or behavior exist from only two areas in the contiguous lower 48 States, one study area in northwestern Montana (Hornocker and Hash 1981) and one study area in central Idaho (Copeland 1996, Magoun and Copeland 1998, Copeland et al. 2007); population-level demographic analysis has recently been conducted in three other study areas of the lower 48 States (Squires et al. 2007), primarily in western Montana and overlapping into the Idaho panhandle. Other studies have been conducted in Alaska (e.g. Magoun and Copeland 1998, Dalerum et al. 2007, Golden et al. 2007), Canada (eg. Rowland et al. 2003, Krebs et al. 2007, Lofroth et al. 2007, Mulders et al. 2007) and other parts of their holarctic range (e.g. Pulliainen 1968, Sæther et al. 2005, May et al. 2006, Persson et al. 2006, Hedmark et al. 2007). Literature reviews, some with analysis of natural history attributes and recommendations for management, have also been conducted (e.g. Shempf and White 1977, White and Barrett 1979, Butts 1992, Copeland and Kucera 1997). Shempf and White (1977) used reported observations of wolverines in California to characterize habitat types and elevational ranges.

In their analysis of broad-scale habitat relations, Aubry et al. (2007) found the only habitat characteristic that fully accounted for the historical distribution (refined to only verifiable and documented records which could be mapped with some degree of precision and excluding anecdotal observations) was persistent spring snow cover through the denning period (mid-April to mid-May), and generally associated with alpine vegetation and alpine climatic conditions. Aubry et al. (2007) speculated that if the persistence of wolverine populations is linked to the availability and quality of relatively deep snow for reproductive den sites (refer to Magoun and Copeland 1998) insufficient snow cover during the denning period could play an important role in limiting their distribution.

Little is known regarding wolverine use in forested habitats. Wolverines have a close association with large ungulate mammals, such as deer. However, habitats managed for deer may not necessarily provide for the wolverine's other life history needs. The low availability of natal dens may limit reproduction in some areas, and physical structure such as coarse woody debris may be important. According to Banci (1994), management prescriptions that successfully provide for the life needs of species such as the Pacific marten, fisher, lynx and their prey will also provide for the needs of wolverine at the stand level. It is not known whether this will provide for wolverine habitat needs at the landscape or larger scales. At the landscape level, the wolverine's large home ranges need to be considered in forest management planning (Banci 1994). However, what is understood about home range size and habitat use is generally from remote, undeveloped northern regions and generally is not known for the Sierra Nevada. White and Barrett (1979) believed that wolverines in California are highly dependent upon mature conifer forests for survival in winter, and generally move downslope in winter into heavier timber where food is available. In their preliminary search for study animals previous to capture for their demographic analysis, Squires et al. (2007) considered all forested areas (excluding ponderosa pine forest) and areas above tree line as potential wolverine habitat.

Wolverines have large spatial requirements; the availability and distribution of food may be the primary factor in determining wolverine movements and home range (Hornocker and Hash 1981, Banci 1994). Individuals may move great distances on a daily basis; in northwestern Montana Hornocker and Hash (1981) found that the maximum distance traveled in 3 days was roughly 40 miles for males, and 24 miles for females. In central Idaho, Copeland et al. (2007) noted that wolverines were capable of crossing their home range in 24 hours. Except for females providing for offspring, or males seeking mates, movement is generally motivated by food (Ruggiero et al. 1994). During summer, long distance movements appear to be restricted to night when temperatures are cooler (Hornocker and Hash 1981). Home ranges of wolverines are generally extremely large and vary greatly depending on gender, availability of food, age, and differences in habitat. In northwestern Montana, Hornocker and Hash (1981) calculated the average annual range of males and females as 163 mi^2 and 150 mi^2, respectively. In central Idaho, Copeland (1996) found that the annual home ranges of resident adult males and females averaged 588 mi^2 and 148 mi^2, respectively. In the Columbia Mountains of southeastern British Columbia, Krebs et al. (2007) calculated the average annual range of males and females as 298 mi^2 and 126 mi^2, respectively, and in the Omineca Mountains of northcentral British Columbia 527 mi^2 and 156 mi^2, respectively. Hornocker and Hash (1981) noted that two lactating females exhibited very similar, greatly reduced spring and summer ranges of approximately 39 mi^2 each. They also stated: "Wolverines exhibited fidelity to a given area, but several individuals of both sexes made frequent long movements to other areas. The length of time spent away from the apparent home area varied from a few days to as long as 30 days. In all instances wolverines returned to the same area." Hornocker and Hash (1981) found that home areas overlapped between individuals of the same and opposite sex, with scent marking maintaining space between individuals in time but not in area. They indicate, however, that mortality (in this trapped population) may have been high enough to keep territorialism from becoming established (Hornocker and Hash 1981).

Wolverines are generally described as opportunistic omnivores in summer and primarily scavengers in winter (Fry 1923, Ruggiero et al. 1994). Copeland et al. (2007) suspected that the minor seasonal variation in habitat use they observed was likely more related to varying food availability than to association with particular vegetation types. Wolverines primarily scavenge carrion in winter, but also prey on small animals and birds, and in summer may eat fruits, berries, and insects (Banci 1994).

In 1977-78, a study conducted by the California Department of Fish and Game did not detect any wolverines in the north Sierras (Hummel 1978). During the winter of 1991-92, the California Deptartment of Fish and Game, University of California Berkeley, and five National Forests conducted a cooperative wolverine study using baited infra-red camera systems at 57 camera stations. Forests involved were the Inyo, Lake Tahoe Basin Management Unit, Shasta-Trinity, Stanislaus, and Tahoe National Forest. No wolverines were detected. During this study, fifteen of the camera units were placed within Tahoe National Forest for various lengths of time. In 1993 and 1994, Tahoe National Forest conducted additional studies using five camera units that were monitored by volunteers. No wolverines were detected. During the winters of 1998 through 2004, 136 baited camera survey stations were conducted primarily on the Sierraville Ranger District to USFS Region 5 protocol (Zielinski and Kucera 1995). Wolverines were not detected during these survey efforts.

Anecdotal sightings of wolverines have been reported in Tahoe National Forest. Ruth (1954) reported a wolverine in Squaw Valley during an Audubon Camp field trip which was observed by about 25 people. Schempf and White (1977) reported three recorded sightings in the Webber Lake area on Sierraville Ranger District, and on Truckee Ranger District near Martis Creek, though these may have been marmots. On Sierraville Ranger District, a wolverine sighting of unknown reliability is recorded near Jackson Meadows Reservoir in 1971, other incidental reports of unknown reliability have come from the public near Webber Lake Falls. More recent incidental sightings that could potentially be wolverine include a 1991 sighting reported in Euer Valley on Truckee Ranger District. A 1992 sighting in the Harding Point area, northeast of Sierraville, was confirmed by track identification. Sightings on the Yuba River Ranger District include one in 1989 in the Haskell Peak area, one in 1990 in the Upper Sardine Lake area, one in 1993 along the Gold Lake Road and Salmon Lake Road area, one in 1998 near Bassett's Station, and one at Sawmill Lake (near Bowman Lake) in 2008. Close to the Tahoe National Forest boundary with Plumas National Forest, sightings have been reported in the Gold Lakes Basin; one around 2006 and one in July 2009. On the Foresthill Ranger District, a wolverine was sighted in the Robinson Flat area in 1980 by a wildlife biologist, in 1992 a wildlife biologist observed a wolverine in the Granite Chief Wilderness Area, and around 2003 a wildlife biologist observed a wolverine near Foresthill.

In 2008, following the confirmed detection of the male wolverine in Tahoe National Forest (discussed in Moriarty et al. 2009), numerous sightings were called in to Tahoe National Forest personnel which vary in date as far back as 1965. These reports include one from Prosser Dam on Truckee Ranger District in August 1965, a report of a dead wolverine found along the Gold Lake Highway in 1972, one from Sawmill Lake in August 1997, one from Bowman Lake Road near Henness Pass in 2000, one in the Webber Lake Falls area in summer 2004, one at Sierra Ski Park in January 2008, and one with unknown year from The Cedars area.

The single male wolverine that was detected in the Sagehen Basin during a research study by Katie Moriarity in 2008 has been detected on the Tahoe NF on a regular basis during the last five years by agency biologists, biologists from the Sierra Pacific Industry on private lands, and public members within the boundary of the Tahoe NF. Genetic information indicates the wolverine appears to be the same lone male individual, and was most recently photographed by a hiker during the spring of 2012 in the Grouse Lakes area. This individual wolverine has been detected over the last several years across approximately a 300-square mile area.

Direct and Indirect Effects

Direct Effects: Direct effects to wolverine from disturbance is been speculated to occur from human activities including winter and summer recreation, housing and industrial development, road corridors, and timber harvest or mining. The Sagehen Project has the potential to directly disturb the wolverine if it were to be in the vicinity of treatment units. However, since the wolverine has a very large home range (~300 sq. mi.), there is a low potential that project treatments would actually coincide with the occurrence of wolverine, since the Saghen Project encompasses less than 3,000 acres and the home range for the wolverine ranges across the Tahoe NF Forest. The Sagehen Project would equate to less than 2 percent of the wolverine's home range. Moreover, the wolverine would likely occupy higher elevation areas (above 8,000 feet) during the summer or fall months when project implementation would take place. However, there is a potential that direct effects from project activities could occur. In addition, since the individual is a single, lone male, it has not been established that there is a natal den site on the Tahoe NF or in the project vicinity. Therefore, natal den sites would not likely be affected by project activities proposed under the action alternatives.

Alternative 1 would have the greatest potential of direct effects to the wolverine, since more than twice the area would be disturbed compared to Alternative 3; and the use of mechanical methods would have greater disturbance potential from noise and felling of large trees. Alternative 3 would disturb wolverine to a lesser extent particularly since the treatments are all hand treatments, with a minor amount of mastication. Alternative 2 would not directly affect the wolverine as no treatments are proposed.

Indirect Effects: Few effects to wolverines from land management actions such as grazing, timber harvest, and prescribed fire have been documented (USDI Fish and Wildlife Service 2013). Proposed forest thinnings and fuels treatments under Alternatives 1 and 3 have the potential to modify wolverine habitat. However, the habitat relationship between wolverines and forest conditions is not well-understood. Wolverines are not considered to be dependent on specific vegetation or habitat features, and there is no evidence that would suggest that land management activities, including forest thinning and fuels reduction are a threat to the conservation of the species. Wolverine habitat fragmentation and decrease is attributed to future climate change. The best available science indicates that other potential stressors, such as land management, infrastructure development, and transportation corridors do not pose a threat to the conservation of the species.

Since, wolverine occupy large home ranges with a variety of habitat conditions, including sparsely vegetated alpine areas to densely forested areas, there is no clear relationship of wolverine habitat requirements other than the need for deep, persistent spring snow cover (April 15 to May 14) is the best

predictor of wolverine occurrence. Wolverine year-round habitat use takes place nearly entirely within the area defined by deep persistent spring snow (Copeland et al. 2010). No records exist of wolverines denning anywhere but in snow, despite the wide availability of snow-free denning habitat within its range. A very small portion (~25%) of the Sagehen Basin has deep persistent snowpack during the spring. Where there is late persistent snow, it is in the upper elevations in the western-most and southern edge of the Basin. Habitat was modeled by Copeland et al. (2009) based on the number of years an area had deep persistent snow into the spring ranging from 1 year to 7 years. The modeled habitat was obtained from Jeff Copeland and used to assess the amount of suitable habitat for the Sagehen Project area. When the modeled wolverine habitat of deep persistent snow coverage is overlayed with the Sagehen Project area, the majority of the suitable wolverine habitat is ranked as low quality where deep snow persisted into the spring for only for 1 to 2 years. A small portion of the area, at the very far edge of the Basin ranked as moderate quality where deep snowpack persisted into the spring for 3 to 5 years. The majority of the Basin and proposed treatment units lie outside of the area with deep persistent snow. Only unit 213 falls within the area that has deep persistent snow, but only for 1 or 2 years, with 7 years being the highest quality habitat. Therefore, the majority of Sagehen Basin is either not suitable to wolverine (for denning) or is marginal at best at the western-most portion of the Basin.

However, it has been suggested that improving habitat for early and mid-seral species, such as deer, may benefit wolverine by improving prey habitat. Therefore, forest thinning activities that enhance forage for deer is likely to improve habitat conditions for wolverine. Alternative 1 would likely benefit wolverine the most compared to Alternative 3, followed by Alternative 2. Alternative 2 would not improve early or mid-seral forest habitat or increase the abundance and distribution of species dependent upon early and mid-seral habitats, such as deer.

Conclusion and Determination

Implementation of Alternatives 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California wolverine within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the California wolverine as discussed previously in this evaluation, and professional judgment. The USDI Fish and Wildlife Service, in their proposed rule to list the wolverine as threatened, state that while land management activities, such as timber harvest, wildland firefighting, prescribed fire, and silvicultural practices can modify wolverine habitat, the wolverine is a habitat generalist and appears to be little affected by changes to the vegetative characteristics. Most wolverines occur at high elevations with rugged terrain that is not conducive to intensive forest management. The Service further states that habitat modifications resulting from the types of treatments proposed for the Sagehen Project would not significantly affect the conservation of the species.

Section 7(a) of the Endangered Species Act requires agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and respect to its critical habitat, if any is designated. Section 49(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in the destruction or adverse modification of proposed critical habitat. If a species is listed

subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. At this time, the USFWS has not proposed designation of critical habitat. Designation of critical habitat will likely include physical and biological features essential to the wolverine, including areas defined by persistent spring snowpack and areas with avalanche debris and talus slopes or boulder fields in which females can construct dens.

The USFWS is proposing a special rule that covers the North American wolverine in the contiguous United States:

- Any activity where wolverines are attempted to be, or are intended to be, trapped, hunted, shot, captures, or collected, in the contiguous U.S., will be prohibited. It will also be prohibited to incidentally trap, hunt, capture, pursue, or collect wolverines in the course of otherwise legal activities. *The Sagehen Project, as proposed, would not trap, hunt, capture, pursue, or collect wolverines.*
- Incidental take of wolverine will not be a violation of Section 9 of the Act, if it occurs from any otherwise legal activities involving wolverines and their habitat that are conducted in accordance with applicable State, Federal, tribal, and local laws and regulations. Such activities occurring in wolverine habitat include:
    - Dispersed recreation such as snowmobiling, skiing, backpacking, and hunting for other species;
    - Management activities by Federal agencies and private landowners such as timber harvest, wildland firefighting, prescribed fire, and silviculture;
    - Transportation corridor and urban development;
    - Mining;
    - Transportation and trade of legally possessed wolverine skins and skins from captive-bred wolverines within the United States.

  Based on this information, the Sagehen Project is consistent with the Section 9 of the Act, and therefore conferencing is not required, since the proposed action alternatives would not likely jeopardize the continued existence of a species proposed for listing or result in the destruction or adverse modification of proposed critical habitat.

MANAGEMENT INDICATOR SPECIES

The purpose of this analysis is to evaluate and disclose the impacts of the Sagehen Project on the habitat of the eleven (11) Management Indicator Species (MIS) identified in the Tahoe National Forest (NF) Land and Resource Management Plan (LRMP) (USDA 1990) as amended by the Sierra Nevada Forests Management Indicator Species Amendment (SNF MIS Amendment) Record of Decision (USDA Forest Service 2007a). This report documents the effects of the proposed action and alternatives on the habitat of selected project-level MIS. This section of the EA is based on the terrestrial wildlife MIS report for the Sagehen Project, hereby incorporated by reference and available by request from the Tahoe National Forest.

Guidance regarding MIS set forth in the Tahoe NF LRMP as amended by the 2007 SNF MIS Amendment ROD directs Forest Service resource managers to (1) at project scale, analyze the effects of proposed projects on the habitat of each MIS affected by such projects, and (2) at the bioregional scale, monitor populations and/or habitat trends of MIS, as identified in the Tahoe NF LRMP as amended.

Table 3.18 below lists the subject species considered. Only those habitats and species designated as Category 3 in the table were determined to be potentially affected and analyzed in detail. Category 2 species habitat may be present in the analysis area, but would not be affected by the Sagehen project. Category 1 species habitat is not present within or adjacent to the project area and would not be affected.

Table 3.18. MIS for Project-Level Habitat Analysis for the Sagehen Project.

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component[1]	Sierra Nevada Forests Management Indicator Species *Scientific Name*	Category for Project Analysis [2]
Shrubland (west-slope chaparral types)	montane chaparral (MCP), mixed chaparral (MCH), chamise-redshank chaparral (CRC)	fox sparrow *Passerella iliaca*	1
Oak-associated Hardwood & Hardwood/conifer	montane hardwood (MHW), montane hardwood-conifer (MHC)	mule deer *Odocoileus hemionus*	1
Riparian	montane riparian (MRI), valley foothill riparian (VRI)	yellow warbler *Dendroica petechial*	2
Early Seral Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, and 3, all canopy closures	mountain quail *Oreortyx pictus*	3
Mid Seral Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree size 4, all canopy closures	mountain quail *Oreortyx pictus*	3

Habitat or Ecosystem Component	CWHR Type(s) defining the habitat or ecosystem component[1]	Sierra Nevada Forests Management Indicator Species *Scientific Name*	Category for Project Analysis [2]
Late Seral Open Canopy Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree size 5, canopy closures S and P	sooty (blue) grouse *Dendragapus obscurus*	2
Late Seral Closed Canopy Coniferous Forest	ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), tree size 5 (canopy closures M and D), and tree size 6.	California spotted owl *Strix occidentalis occidentalis*	3
		Pacific marten *Martes americana*	
		northern flying squirrel *Glaucomys sabrinus*	
Snags in Green Forest	Medium and large snags in green forest	hairy woodpecker *Picoides villosus*	3
Snags in Burned Forest	Medium and large snags in burned forest (stand-replacing fire)	black-backed woodpecker *Picoides arcticus*	1

[1] All CWHR size classes and canopy closures are included unless otherwise specified; **dbh** = diameter at breast height; **Canopy Closure classifications:** S=Sparse Cover (10-24% canopy closure); P= Open cover (25-39% canopy closure); M= Moderate cover (40-59% canopy closure); D= Dense cover (60-100% canopy closure); **Tree size classes:** 1 (Seedling)(<1" dbh); 2 (Sapling)(1"-5.9" dbh); 3 (Pole)(6"-10.9" dbh); 4 (Small tree)(11"-23.9" dbh); 5 (Medium/Large tree)(≥24" dbh); 6 (Multi-layered Tree) [In PPN and SMC] (Mayer and Laudenslayer 1988).

[2] **Category 1:** MIS whose habitat is not in or adjacent to the project area and would not be affected by the project.
Category 2: MIS whose habitat is in or adjacent to project area, but would not be either directly or indirectly affected by the project.
Category 3: MIS whose habitat would be either directly or indirectly affected by the project.

The fox sparrow, mule deer, and black-backed woodpecker, identified as category 1 above, will not be discussed further as the habitat components they were selected for as Management Indicator Species do not exist within the Sagehen Analysis Area and would therefore not be affected by the proposed project.

The Late Seral Open Canopy Coniferous Forest habitat component of the sooty grouse does occur in the Sagehen Analysis Area but does not occur within units receiving treatment, therefore the proposed project and alternatives would not alter this habitat type. The riparian habitat component of the yellow warbler exists within project units but would only receive a small amount of underburning which would be allowed to creep in from neighboring units but would not be intentionally underburned as discussed in the Standard Management Requirements, Appendix A, contained in the Sagehen Environmental Assessment. This small amount of incidental underburning would not affect riparian MIS habitat. The sooty grouse and yellow warbler, identified as category 2 above, will not be discussed further because the proposed action and alternative would not alter the habitat component selected for these species.

The MIS whose habitat would be either directly or indirectly affected by the Sagehen Project, identified as Category 3 in Table 3.18, are carried forward in this analysis, which will evaluate the direct, indirect, and cumulative effects of the proposed action and alternatives on the habitat of these MIS. The MIS selected for project-level MIS analysis for the Sagehen Project are: mountain quail, California spotted owl, Pacific marten, northern flying squirrel, and hairy woodpecker.

Habitat Data and Analysis Metrics for Effects

The analysis of the effects of the Sagehen Project on the MIS habitat for the selected project-level MIS is conducted at the project scale. This analysis used the following habitat data: Forest inventory data, stand examinations, remotely sensed vegetation, basal area plots, and GIS vegetation data. Forest inventory data collected from more than 500 permanent vegetation plots by UC Berkeley researchers in 2006 provided the basis for quantifying existing conditions in the proposed treatment units. The Forest Vegetation Simulator (FVS) model (South Central Oregon Northern California variant) was used to "grow" the inventory data forward to represent conditions post Sagehen Project implementation. The California Habitat Relationships (CWHR) GIS vegetation data was updated for this project and used along with the FVS to predict vegetation type changes following project implementation.

California Wildlife Habitat Relationship (CWHR) vegetation classifications are used throughout this document to describe changes to selected MIS habitat types. These classifications describe the dominant vegetation type (tree species), tree size, and canopy cover. The MIS are defined in terms of CWHR habitat types important to each species throughout the Sierra Nevada Bioregion. By showing changes to important habitat attributes i.e. canopy cover, we can quantify effects to habitat. By quantifying changes to CWHR classifications we can identify the status and trends of those habitat types within the proposed project and within the bioregion. Changes to CWHR classifications are discussed for all MIS habitat components affected by the proposed project.

Early and Mid Seral Coniferous Forest Habitat (Mountain Quail)

Habitat/Species Relationship.
The mountain quail was selected as the MIS for early and mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat in the Sierra Nevada. Early seral coniferous forest habitat is comprised primarily of seedlings (<1" dbh), saplings (1"-5.9" dbh), and pole-sized trees (6"-10.9" dbh). Mid seral coniferous forest habitat is comprised primarily of small-sized trees (11"-23.9" dbh). The mountain quail is found particularly on steep slopes, in open, brushy stands of conifer and deciduous forest and woodland, and chaparral; they may gather at water sources in the summer, and broods are seldom found more than 0.8 km (0.5 mi) from water (CDFG 2005).

Project-level Effects Analysis – Early and Mid Seral Coniferous Forest Habitat
Habitat Factor(s) for the Analysis: (1) Acres of early (CWHR tree sizes 1, 2, and 3) and mid seral (CWHR tree size 4) coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, red fir, and eastside pine) habitat [CWHR ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), eastside pine (EPN), tree sizes 1, 2, 3, and 4, all canopy closures]. (2) Acres with changes in CWHR tree size class. (3) Acres with changes in tree canopy closure. (4) Acres with changes in understory shrub canopy closure.

Current Condition of the Habitat Factor(s) in the Analysis Area: There are an estimated 2,152 acres of early seral coniferous habitat and 12,354 acres of mid seral coniferous habitat located within the analysis area of 29,467 acres (1.5 miles surrounding the proposed project boundary). The current CWHR tree canopy closure classifications within the analysis area for early seral habitat are: 862 acres of "S" (10-24% canopy cover), 657 acres of "P" (25-39% canopy cover), 254 acres of "M" (40-59% canopy cover), and 379 acres of "D" (60-100% canopy cover). Mid seral CWHR tree canopy closure classifications within the analysis area are: 1,587 acres of "S", 3,565 acres of "P", 3,465 acres of "M", and 3,737 acres of "D". Shrub canopy cover is not quantified for this area, and the current condition is unknown.

<u>Alternative 1 (Proposed Action)</u>
Direct and Indirect Effects to Habitat: Within the Sagehen Analysis Area changes to early and mid seral mountain quail habitat as defined above would be minimal. There are no identified changes in CWHR typed early seral habitat. There would be a net loss of 5 acres of mid seral coniferous habitat in Unit 80 (0.04% of the available mid seral habitat). Treatment in Unit 80 involves the removal of the conifers in order to promote and facilitate aspen restoration. This treatment will type convert the previously 5 acre mid seral coniferous forest stand to an aspen stand (CWHR type ASP), which is not identified as a habitat type tracked for mountain quail as an MIS.

The dominant tree size as defined by the CWHR typing would remain in the classifications 1-4 (<1"-24"dbh) and would therefore not create or remove existing mountain quail habitat as defined by the MIS designation. Treatments are not proposed in any stands with size class 1 or 2 trees. Proposed treatments in size class 3 (early seral) and size class 4 (mid seral) are largely comprised of removing the smaller trees in these stands. In size class 3 stands, most trees removed would be less than 10" dbh, whereas in size class 4 stands, most trees removed would be less than 20" dbh. The numbers and sizes

of trees removed in these stands would not be sufficient to shift the average size class of the stand into a smaller class. The overall size classes of identified early and mid seral coniferous forest stands would remain the same post treatment.

Although the proposed action would not change the dominant tree size class, it would affect canopy cover. Reductions in canopy cover are expected to occur in all proposed treatment units under Alternative 1 but only some reduction in CWHR canopy cover classifications are predicted. Changes to canopy cover classifications within the analysis area would not occur within the 2,152 acres of early seral mountain quail MIS habitat and would only affect 6% (756 acres) of the 12,354 acres of mid seral habitat. An estimated 35.25 acres of mid seral mountain quail MIS habitat would change from a "D" (>60% canopy cover) classification to a "P" (25-39% canopy cover) classification, 698.95 acres would change from a "D" classification to a "M" (40-59% canopy cover) classification, 17.08 acres would change from a "M" to a "P" (25-39% canopy cover) classification, 4.9 acres would change from a "D" to an ASP (aspen) classification, and .15 acres would change from a "P" classification to an ASP (aspen) classification. Aspen is not included in the selected habitat component for mountain quail MIS so would therefore reduce the amount of mountain quail habitat by 5 acres as discussed above. Even with these reductions, except for the 5 acre conversion to aspen, all canopy cover reductions would not decrease the amount of early and mid seral mountain quail habitat because all canopy closures are considered suitable for early and mid seral habitat. Therefore the overall amount of mountain quail MIS habitat is not substantially negatively affected.

Shrub canopy cover is not quantified under the CWHR system so cannot be discussed in terms of direct changes to canopy cover classes but direct effects to shrub canopy cover are expected on a maximum of 822 acres (5.6%) of the early and mid seral mountain quail MIS habitat within the analysis area that will receive mastication or underburning treatments. The number of acres containing a shrub component within the 822 acres of early and mid seral habitat is unknown but a shrub component is present across much of the early and mid seral habitat within the analysis area. Direct effects to shrub canopy cover would be caused in units that would receive mastication or underburning treatments. Within the analysis area 19 (0.9%) acres of early seral habitat and 116 (0.9%) acres of mid seral habitat would be masticated. Mastication would remove all shrubs under the drip line of retained trees but would retain bitter brush and *Ribes* species outside of the drip line. It is expected that the decrease in the shrub component affected by mastication would be temporary. Some shrub component would be retained in the masticated units and some would either regenerate or be replaced by other shrub species over time. Within the analysis area, underburning would occur in 14 acres (0.7%) of early seral habitat and 673 acres (5.4%) of mid seral habitat. Underburning leaves a mosaic of shrub cover, burning some shrub patches and leaving others. In addition, within each underburning unit, 30% of the unit would not be burned, and where patches of bitterbrush, low sagebrush and mountain sagebrush cover at least half of an acre, 30% or less of the patch would be burned. Shrubs within the unburned area would remain, and shrubs that are burned would regenerate. Under Alternative 1, an Early Seral Opening treatment on 54 acres is also prescribed. Areas within these 54 acres already containing a shrub component would have canopy cover removed and allow for some additional shrubs to grow. This additional area is difficult to quantify and would be site dependent but would provide some increase in shrub canopy cover.

Although some of the existing shrub component within treatment units would be affected by Alternative 1, it is expected that the effects would be temporary since most of the shrubs would regenerate over time. It is also expected that because the silvicultural prescriptions would occur over a 5 year period and fire/fuels prescription would occur over a 15 year period, shrub removal and regrowth would occur in different stages providing some shrub habitat to return which would limit the areas containing no shrub component as a result of the proposed project.

Under Alternative 1, mountain quail MIS habitat would be reduced by 5 acres of mid seral habitat which will be converted to aspen and would no longer be defined as mid seral habitat. There would be changes to overstory canopy cover and shrub canopy cover as a result of Alternative 1 but the changes would not reduce the amount of available early and mid seral habitat. The total reduction of 5 acres of mountain quail habitat is 0.03% of the total available early and mid seral habitat within the analysis area.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: Direct and indirect effects to habitat would not occur because no action would be taken. CWHR types would remain the same as the pre-treatment condition.

Alternative 3 (Non-Commercial Funding Alternative)

Direct and Indirect Effects to Habitat: Under Alternative 3, the units proposed for treatment are greatly reduced (1,132 acres) vs. Alternative 1 (2,621 acres). The analysis area for Alternative 3 will remain the same as for Alternative 1, therefore the acres of early and mid seral habitat will remain the same. Treatments proposed under Alternative 3 would not change the dominant tree size as defined by the CWHR typing so it would remain in the classifications 1-4 (<1”-24”dbh) and would not change existing mountain quail habitat as defined by the MIS designation. Canopy cover would be reduced in all units proposed for treatment under Alternative 3. There would be some changes to CWHR canopy cover classifications for mid seral habitat but not for early seral habitat. Mid seral habitat CWHR canopy cover classification would change from a “D” to an “M” classification on 31.86 acres which is 0.3% of the mid seral habitat in the analysis area. This reduction in canopy cover would not decrease the amount of early and mid seral mountain quail habitat because all canopy closures are considered suitable for early and mid seral habitat. Therefore the overall amount of mountain quail MIS habitat is not negatively affected.

Shrub canopy cover is not quantified under the CWHR system so cannot be discussed in terms of direct changes to canopy cover classes but direct effects to shrub canopy cover are expected on a maximum of 311acres (2%) of the early and mid seral mountain quail MIS habitat within the analysis area. In units proposed for treatment under Alternative 3, shrub canopy cover would receive the same direct effects as Alternative 1 discussed above. Alternative 3 proposes treatment in fewer acres of early and mid seral habitat and focuses on fuels treatments including mastication and underburning. Alternative 3 proposes to masticate 19 acres (0.9%) of early seral habitat and 110 acres (0.9%) of mid seral habitat within the analysis area. Underburning is proposed for 14 acres (0.6%) of early seral habitat and 168 acres (1.4%) of mid seral habitat within the analysis area. As discussed for Alternative 1, the direct effects to the

shrub component are expected to be temporary and spread out over 5 years for silvicultural prescriptions and 15 years for fuels treatments. Under Alternative 3 there are no early seral openings prescribed for the treated units, and therefore there would not be an increase to the shrub components as a result of that prescription.

Bioregional Habitat, Population and Project Related Effects: There are currently 530,851 acres of early seral and 2,776,022 acres of mid seral coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat on National Forest System lands in the Sierra Nevada. Over the last two decades, the trend for early seral is decreasing (changing from 9% to 5% of the acres on National Forest System lands) and the trend for mid seral is increasing (changing from 21% to 25% of the acres on National Forest System lands).

Monitoring of the mountain quail across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes fox sparrow, hairy woodpecker, and yellow warbler (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). In addition, mountain quail continue to be monitored and surveyed in the Sierra Nevada at various sample locations by hunter survey, modeling, and breeding bird survey protocols. These are summarized in the 2008 Bioregional Monitoring Report (USDA Forest Service 2008). Current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of mountain quail populations in the Sierra Nevada is stable.

The direct and indirect effects of the Sagehen Project would have a negligible effect on early and mid seral mountain quail MIS habitat. Effects of the proposed action alternatives have would alter overstory canopy cover and shrub canopy cover but would not alter the habitat in such a way that would cause it to be unsuitable to mountain quail. The small reduction in acres of early and mid seral mountain quail habitat (6 acres, under Alternative 1 only, of the 3,306,873 acres of habitat on National Forest System lands in the Sierra Nevada) would not alter the existing trend in habitat, nor would it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, Pacific marten, and northern flying squirrel)

Habitat/Species Relationship.

California spotted owl: The California spotted owl was selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The California spotted owl is strongly associated with forests that have a complex multi-layered structure, large-diameter trees, and high canopy closure (CDFG 2005, USFWS 2006). It uses dense, multi-layered canopy cover for roost seclusion; roost selection appears to be related closely to thermoregulatory needs, and the species appears to be intolerant of high temperatures (CDFG 2005). Mature, multi-layered forest stands are required for breeding (Ibid). The mixed-conifer forest type is

the predominant type used by spotted owls in the Sierra Nevada: about 80 percent of known sites are found in mixed-conifer forest, with 10 percent in red fir forest (USDA Forest Service 2001).

Pacific marten: The Pacific marten was selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. Martens prefer coniferous forest habitat with large diameter trees and snags, large down logs, moderate-to-high canopy closure, and an interspersion of riparian areas and meadows. Important habitat attributes are: vegetative diversity, with predominately mature forest; snags; dispersal cover; and large woody debris (Allen 1982). Key components for westside and eastside marten habitat can be found in the Sierra Nevada Forest Plan Amendment FEIS (USDA Forest Service 2001), Volume 3, Chapter 3, part 4.4, pages 20-21.

Northern flying squirrel. The northern flying squirrel was selected as an MIS for late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat in the Sierra Nevada. This habitat is comprised primarily of medium/large trees (equal to or greater than 24 inches dbh) with canopy closures above 40% within ponderosa pine, Sierran mixed conifer, white fir, and red fir coniferous forests, and multi-layered trees within ponderosa pine and Sierran mixed conifer forests. The northern flying squirrel occurs primarily in mature, dense conifer habitats intermixed with various riparian habitats, using cavities in mature trees, snags, or logs for cover (CDFG 2005).

Project-level Effects Analysis – Late Seral Closed Canopy Coniferous Forest Habitat.
Habitat Factor(s) for the Analysis: (1) Acres of late seral closed canopy coniferous forest (ponderosa pine, Sierran mixed conifer, white fir, and red fir) habitat [CWHR ponderosa pine (PPN), Sierran mixed conifer (SMC), white fir (WFR), red fir (RFR), tree size 5 (canopy closures M and D), and tree size 6]. (2) Acres with changes in canopy closure (D to M). (3) Acres with changes in large down logs per acre or large snags per acre.

Current Condition of the Habitat Factor(s) in the Project Area: There are an estimated 1,079 acres of late seral closed-canopy coniferous forest habitat within the analysis area of 29,467 acres (1.5 miles surrounding the proposed project boundary). Out of the 1,079 acres of late seral closed-canopy coniferous forest habitat that occurs within the analysis area only 1.5 acres occur within project unit boundaries for Alternative 1 and no habitat occurs within the project boundary for Alternative 3. Snag density within the 1.5 acres of habitat that occur within the unit boundary are estimated at 3 snags per acre with a dbh of 15-30” and there are no snags greater than 30” dbh. Logs greater than 15”dbh are estimated at 9 per acre within the 1.5 acres of late seral closed-canopy coniferous forest habitat that occurs within the Alternative 1 treatment units.

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat: Within the Sagehen Analysis Area changes to late seral closed-canopy coniferous habitat type would occur on 1.5 acres of the 1,079 acres of habitat (0.1%). This change in CWHR typing would occur as a result of canopy cover reduction from a "D" classification to an "M" classification. This would not result in a reduction of late seral closed-canopy coniferous habitat type as canopy cover in the "M" classification is still within the parameters of the selected MIS habitat.

Changes to large snag and large down logs are expected as a result of Alternative 1 throughout the treatment units. Over time, the expected outcome of treatments proposed under Alternative 1 would alter tree mortality rates. Current tree mortality rates would increase snags per acre at a faster rate than would occur after the proposed treatments were implemented. The high level of mortality under current conditions is a result of unnaturally dense forests and is thought to be unsustainable. Current tree mortality occurs mostly in trees less than 15"dbh. The high mortality in this age class results in fewer trees reaching larger size classes. It is expected that once competition and resource stress caused by dense second growth forest is lessened by the proposed treatments, medium and large tree mortality would decrease, therefore decreasing snag recruitment. For the long term, as medium and large trees increase in size, snag size would also increase as a result of a mortality rate that would be more sustainable.

Large snags greater than 30"dbh are extremely limited within the project area and it is one of the objectives of the proposed action to create a forest that would produce this important wildlife attribute over time. While treatments to the large snag and the large down log habitat attributes within the late seral closed-canopy habitat would follow specific management objectives aimed at enhancing Pacific marten habitat, these objectives would also benefit California spotted owls and northern flying squirrels. As one of the objectives of Alternative 1, habitat enhancement would include retaining a larger number of snags per acre and large down logs per acre and partially girdling some live trees to create opportunities for additional snag recruitment in the future. All snags over 15" dbh would be retained, and where snags are below desired densities, 1-3 trees per acre 15-30"dbh would be partially girdled. In addition to girdling trees, short snags would be created to increase resting sites and subnivean access for the Pacific marten. Snag retention would meet (and in many cases exceed) Forest Plan standards and guidelines (SNFPA ROD pg. 51). In late seral closed-canopy habitat receiving underburning, 15 to 20 large down logs would be lined per acre to retain those logs. Areas treated under Alternative 1 are expected to promote the growth of larger trees as a result of decreased competition and increasing forest health. These larger trees in time would result in an increase in larger snag and larger log recruitment, improving this habitat component for the selected MIS species, California spotted owl, Pacific marten, and northern flying squirrel.

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: Direct and indirect effects would not occur because no action would be taken. All of the late seral closed-canopy coniferous forest habitat and associated forest habitat attributes would remain in their current condition.

Alternative 3 (Non-Commercial Funding Alternative)

Direct and Indirect Effects to Habitat: The proposed treatment areas for Alternative 3 do not contain late seral closed-canopy coniferous forest habitat and would therefore not have an effect to this habitat type.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Trends

California spotted owl: Implementation of the proposed project alternatives would not reduce late seral closed-canopy habitat, would retain current large snags and large down wood, and would create a condition that would increase the amount of large snags and down wood in the future (under Alternative 1). The Sagehen Project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of California spotted owls across the Sierra Nevada bioregion.

Pacific marten: Implementation of the proposed project alternatives would not reduce late seral closed-canopy habitat, would retain current large snags and large down wood, and would create a condition that would increase the amount of large snags and down wood in the future (under Alternative 1). The Sagehen Project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of Pacific marten across the Sierra Nevada bioregion.

Northern flying squirrel: Implementation of the proposed project alternatives would not reduce late seral closed-canopy habitat, would retain current large snags and large down wood, and would create a condition that would increase the amount of large snags and down wood in the future (under Alternative 1). The Sagehen Project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of northern flying squirrel across the Sierra Nevada bioregion.

Snags in Green Forest Ecosystem Component (Hairy woodpecker)

Habitat/Species Relationship

The hairy woodpecker was selected as the MIS for the ecosystem component of snags in green forests. Medium (diameter breast height between 15 to 30 inches) and large (diameter breast height greater than 30 inches) snags are most important. The hairy woodpecker uses stands of large, mature trees and snags of sparse to intermediate density; cover is also provided by tree cavities (CDFG 2005). Mature timber and dead snags or trees of moderate to large size are apparently more important than tree species (Siegel and DeSante 1999).

Project-level Effects Analysis – Snags in Green Forest Ecosystem Component

Habitat Factor(s) for the Analysis: (1) Medium (15-30 inches dbh) snags per acre. (2) large (greater than 30 inches dbh) snags per acre.

Current Condition of the Habitat Factor(s) in the Project Area: Forest inventory data was used with the Forest Vegetation Simulator model to estimate current and future medium (15-30”dbh) and large (>30”dbh) snag densities (current, 30 and 50 years into the future) for each of the 3 alternative treatments. Snags per acre were only calculated within the unit boundaries of the proposed Sagehen Project and do not include the area outside the units but within the analysis area. Snags outside of the

unit boundary but within the analysis area would not be affected by the proposed project and would therefore remain at current levels unless proposed for treatment under current and future projects as discussed in the cumulative effects section.

Current estimated snag densities within areas containing young, small trees (plantations or trees naturally regenerated after a wildfire) range from medium snags, 0 to 0.38 snags per acre, and large snags from 0 to 1.08 snags per acre. These units containing young trees, Units 46, 47, 76, 87, 98, and 99, as a result of past wildfires, have not reached tree sizes that would allow mortality in the medium and large size classes. Therefore these units have a much lower numbers of snags per acre than in the remainder of the project units. Outside of plantations and natural regenerating young forest types, snag densities range from an estimated 1.18 to 6.63 snags per acre in the medium size class and 0 to 2.53 snags per acre in the large size class.

Alternative 1 (Proposed Action)

Direct and Indirect Effects to Habitat: Within the 2,621 acres proposed for treatment under Alternative 1, snag size and density is expected to be affected. The acres that would be affected as a result of the proposed action would include all areas receiving treatment within the project area. Under the proposed action, current medium and large snags would be retained but snag recruitment is expected to be reduced as compared to recruitment levels in forest not receiving treatment. Current tree mortality rates would increase snags per acre at a faster rate than would occur after the proposed treatment was implemented. This high level of mortality is a result of unnaturally dense forests and is thought to be unsustainable. Current tree mortality and expected future mortality without treatment occurs mostly in trees less than 15”dbh. The high mortality in this age class results in fewer trees reaching larger size classes. It is expected that once competition and resource stress caused by dense second growth forests is lessened by the proposed treatments, medium and large tree mortality would decrease therefore decreasing snag recruitment. For the long term, as trees increase in size, snag size would also increase. Large snags greater than 30”dbh are extremely limited within the project area and it is one of the objectives of the proposed action to create a forest that would produce this important wildlife attribute over time at a rate that is closer to natural conditions.

Under Alternative 1, where the current snag densities are substantially below desired concentrations, 1-3 trees per acre 15-30” dbh would be partially girdled. Partially girdling trees would cause them to weaken and die over a longer timeframe, which would help increase the future number of snags in areas containing below desirable levels. Desired density of snags was determined by the objective of each emphasis area. If an area was determined to be suitable to the Pacific marten, and snags were at low levels, additional snags would be created using partial girdling. Areas shown to have low levels of snag densities and are not prescribed additional snag creation, were areas that additional medium or large snags would not be possible, such as in plantations, or areas that snags were naturally at lower levels such as in areas with naturally lower stand density. Although the proposed treatment would decrease snag recruitment; snag retention would meet, (and in many cases exceed) Forest Plan standards and guidelines (SNFPA ROD pg. 51).

Alternative 2 (No Action)

Direct and Indirect Effects to Habitat: Direct and indirect effects would not occur because no action would be taken. The snags in green forests ecosystem component would remain in its current condition.

Alternative 3 (Non-Commercial Funding Alternative)

Direct and Indirect Effects to Habitat: Direct effects to snags would occur on the 1,132 acres proposed for treatment under Alternative 3. Of the acres containing a snag component within the analysis area, 4% would be affected by Alternative 3. Since the units proposed for treatment under Alternative 3 would receive the same treatments as under Alternative 1 in that thinning would be conducted to reduce tree competition, the effects on the snag recruitment component would be the same for both alternatives. However, treatments in Alternative 3 do not include the creation of snags through partial girdling. Units not purposed to receive treatment under Alternative 3 would be receive the same effects as Alternative 2, the No Action Alternative.

Summary of Hairy Woodpecker Status and Trend at the Bioregional Scale

The Tahoe NF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the hairy woodpecker; hence, the snag effects analysis for the Sagehen Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data for the hairy woodpecker. This information is drawn from the detailed information on habitat and distribution population trends in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a), which is hereby incorporated by reference.

Ecosystem Component Status and Trend. The current average number of medium-sized and large-sized snags (≥ 15" dbh, all decay classes) per acre across major coniferous and hardwood forest types (westside mixed conifer, ponderosa pine, white fir, productive hardwoods, red fir, eastside pine) in the Sierra Nevada ranges from 1.5 per acre in eastside pine to 9.1 per acre in white fir. In 2008, snags in these types ranged from 1.4 per acre in eastside pine to 8.3 per acre in white fir (USDA Forest Service 2008).

Data from the early-to-mid 2000s were compared with the current data to calculate the trend in total snags per acre by Regional forest type for the 10 Sierra Nevada national forests and indicate that, during this period, snags per acre increased within westside mixed conifer (+0.76), white fir (+2.66), productive hardwoods (+0.35), and red fir (+1.25) and decreased within ponderosa pine (-0.16) and eastside pine (-0.14). Detailed information by forest type, snag size, and snag decay class can be found in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

Population Status and Trend. Monitoring of the hairy woodpecker across the ten National Forests in the Sierra Nevada has been conducted since 2009 in partnership with PRBO Conservation Science, as part of a monitoring effort that also includes the mountain quail (USDA Forest Service 2010a, http://data.prbo.org/partners/usfs/snmis/). Hairy woodpeckers were detected on 15.1% of 1659 point

counts (and 25.2% of 424 playback points) in 2009 and 16.7% of 2266 point counts (and 25.6% of 492 playback points) in 2010, with detections on all 10 national forests in both years. The average abundance (number of individuals recorded on passive point count surveys) was 0.116 in 2009 and 0.107 in 2010. These data indicate that hairy woodpeckers continue to be distributed across the 10 Sierra Nevada National Forests. In addition, the hairy woodpeckers continue to be monitored and surveyed in the Sierra Nevada at various sample locations by avian point count and breeding bird survey protocols. These are summarized in the 2008 Bioregional Monitoring Report (USDA Forest Service 2008).Current data at the rangewide, California, and Sierra Nevada scales indicate that the distribution of hairy woodpecker populations in the Sierra Nevada is stable.

Relationship of Project-Level Habitat Impacts to Bioregional-Scale Hairy Woodpecker Trend: Implementation of the proposed project alternatives would retain current medium and large snags, and would create a condition that would increase the amount of medium and large snags in the future. The Sagehen Project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of the hairy woodpecker across the Sierra Nevada bioregion.

Aquatic Wildlife

This section of the EA summarizes the findings of the Sagehen Project Aquatic Species Biological Evaluation (BE) (December, 2012) which is hereby incorporated by reference and available upon request. The spatial extent of the analysis area for the BE includes the lower and upper Sagehen Creek watershed catchments, and is comprised of approximately 10,412 acres. The analysis area was chosen because it considers the riparian habitats associated with the proposed Sagehen Project and the overall condition of the watersheds that the species within this project area may inhabit. Sagehen Creek is an eastward trending headwater tributary flowing into the south east arm of Stampede Reservoir.

The Aquatic BE determined that implementation of the Sagehen Project would not affect the following special status species because the Sagehen Project analysis area is outside the current and/or historic range of the species: California red-legged frog (U.S.F.W.S. Threatened), Foothill yellow-legged frog (Forest Service Sensitive), Lahontan Lake tui chub (Forest Service Sensitive), Hardhead (Forest Service Sensitive), Northwestern pond turtle (Forest Service Sensitive) and California floater mussel (Forest Service Sensitive).

The following special status species have habitat or potential habitat within the project analysis area but will not be affected by project activities: Lahontan cutthroat trout (U.S.F.W.S. Threatened) and Great Basin ram horn snail (Forest Service Sensitive). Sierra Nevada yellow-legged frog (U.S.F.W.S Candidate, Forest Service Sensitive) has been detected within the Sagehen Project analysis area; individuals of Sierra Nevada yellow-legged frog, *Rana sierrae,* may be affected by project activities, but this is not likely to result in a trend toward Federal listing or loss of viability for this species. These determinations and the potential effects from implementation of Alternative 1 and Alternative 3 to the species are discussed below and analyzed in greater detail in the Aquatic BE. Since Alternative 2 does not propose any

activities within the analysis area, there would be no effects to species beyond existing trends from selection of this alternative and for that reason it is not discussed further below. Cumulative effects to the subject species are discussed later in Chapter 3 under FONSI Element #7.

Species Specific Determinations

LAHONTAN CUTTHROAT TROUT (Oncorhynchus clarki henshawi)

Status: USFWS Threatened

The Lahontan cutthroat trout (LCT) was listed by the USFWS as an endangered species in 1970 (USDI Fish and Wildlife Service 1970; 35 FR 13520). The listing was reclassified to threatened status in 1975 to facilitate recovery and management efforts and to authorize regulated angling (USDI Fish and Wildlife Service 1975; 40 FR 29864). Currently, no Critical Habitat has been designated for the Lahontan cutthroat trout (USDI Fish and Wildlife Service 1995).

LCT is an inland subspecies (one of 14 recognized subspecies of cutthroat trout in the western United States) of cutthroat trout endemic to the Lahontan Basin of northern Nevada, eastern California, and southern Oregon. In northern California and western Nevada, Lahontan cutthroat trout were thought to occupy approximately 360 miles of the Truckee River, 300 miles of the Carson River, and 360 miles of the Walker River (Somer 1998). Due to the fragmented, isolated nature of lake and stream populations, Lahontan cutthroat trout may be at a high risk for extinction (USDI Fish and Wildlife Service 1995, Somer 1998). The severe decline in range and numbers of Lahontan cutthroat trout is attributed to a number of factors including hybridization and competition with introduced trout species; alteration of stream channels and morphology; loss of spawning habitat due to pollution and sediment inputs from logging, mining, grazing and urbanization; migration blockage due to dams; reduction of lake levels and concentrated chemical components in natural lakes; loss of habitat due to channelization; de-watering due to irrigation and urban demands; and overfishing (Gerstung 1986 & 1988, Coffin 1988, USDI Fish and Wildlife Service 1995).

Within the Tahoe National Forest, recovery populations of LCT occur in one lake and five streams. Tahoe National Forest has designated the lake (Independence Lake) and the stream flowing into it (Upper Independence Creek) as a critical Aquatic Refuge (CAR). Management decisions and actions in a CAR should reflect the unique and important nature of the aquatic and riparian resources in these areas. Periodically CDF&G surveys streams by electroshocker to determine LCT population trends. All populations in Tahoe National Forest have been stable over the past five years. However, these populations should be considered at risk since they are not at carrying capacity and have not shown an increase over the years surveyed.

Project units located within the Sagehen Basin are within historic LCT habitat. Various surveys (snorkeling and electro fishing) conducted by Tahoe National personnel between 2000 and 2005 have not found any LCT in the Sagehen Creek. In 2005, Jonathan Stead explored the reintroduction of two strains of LCT within Sagehen Creek for a master's thesis. He introduced two hatchery propagated strains of LCT; Pilot Peak and Independence for a young-of-the year strain evaluation. In 2006, he conducted a yearling strain evaluation which included the same

two strains, and added wild LCT which was collected from Austin Meadow Creek. Upon completion of the experiment in 2006, Virginia Boucher working with Pete Moyle from UC Davis have been conducting annual electrofishing in Sagehen Creek. A total of nine transects are established throughout the length of Sagehen Creek. Efforts from surveys have not captured LCT, concluding the reintroduced fish did not persist (Boucher, personal communication, unpublished data).

Sagehen Creek and its tributaries does contain suitable physical habitat for this species, but may be rendered biologically difficult in its current state due to the ubiquitous presence of non-native salmonid species, including the following: brook trout (*Salvelinus fontinalis*), rainbow trout (Oncorhynchus mykiss), Kokanee salmon (*Oncorhynchus nerka*)(below HWY 89 road crossing, and brown trout (*Salmo trutta*). Because of the experimental nature of the Sagehen Field Station, Sagehen Creek is still a high priority area of interest for more experiments involving the reintroduction of LCT.

For the following reasons the Lahontan cutthroat trout will not be considered for further analysis: (1) this species is not present within the Sagehen Project aquatic analysis area, (2) though suitable physical habitat is present within the project analysis area, significant changes to habitat condition/quantity are not predicted to occur under any Sagehen Project alternatives and should remain stable in the future, and (3) actions implemented with this project would not preclude future reintroductions or experiments of LCT.

Direct species effects would not occur since the species is absent from the analysis area and project activities, including road building, will not occur near extant LCT populations. There is a slight risk for indirect habitat effects. The location and treatment types within RCAs have been considered and it is my conclusion that the possibility of effects to the stream channel condition is not significant. If effects occur, these indirect habitat effects would be minimal and would not occur within occupied LCT habitat. In summary, there will be no direct, indirect, or cumulative effects to occupied LCT habitat under any of the Alternatives. Indirect effects to suitable unoccupied LCT habitat should be minimal due to standard management requirements and RCA protection measures designed into the Sagehen Project.

Determination

Based on the analysis, implementation of Alternative 1 or Alternative 3 will not affect the Lahontan cutthroat trout, *Oncorhynchus clarki henshawi* or its designated critical habitat.

SIERRA NEVADA YELLOW-LEGGED FROG (Rana sierrae)

Status: USFS R5 Sensitive, USFWS Candidate (Sierra Nevada DPS)

Within the Tahoe National Forest, Sierra Nevada yellow-legged frog (MYLF) is listed as a USFS R5 Sensitive and as a USFWS Candidate species, being part of the Sierra Nevada Distinct Population

Segment (DPS) as defined by the USFWS (formerly known as Mountain yellow-legged frog, *Rana Muscosa)*. On January 10, 2003 (and as revised on June 25, 2007) the USFWS found that listing of the Sierra Nevada DPS as threatened or endangered was warranted but precluded by higher priority actions and the species was listed as a Candidate (USDI Fish and Wildlife Service 2003; 68 FR 2283, and revised by USDI Fish and Wildlife Service 2007; 72 FR 34657). A separate disjunct population, the southern California DPS, was listed as Endangered by the USFWS effective August 1, 2002 (USDI Fish and Wildlife Service 2006; 67 FR 44382), and critical habitat was designated for the southern California DPS on October 16, 2006 (USDI Fish and Wildlife Service 2006; 71 FR 54344).

MYLF occurs in the Sierra Nevada from around 4,500 feet to over 12,000 feet elevation, and inhabits ponds, lakes, and streams of sufficient depth for overwintering (Jennings and Hayes 1994). All age classes (subadult and adult frogs and larvae) overwinter underwater; in high elevations they are restricted to relatively deep lakes (over 5 feet deep) that do not freeze solid in winter (Knapp 1994, Knapp and Matthews 2000). Little is known about their habitat requirements in spring, stream, and pond habitats where they are typically found in Tahoe National Forest. Based on habitat characteristics of occupied locations, they are thought to overwinter in spring and stream habitats, possibly less than 3 feet deep, that do not freeze solid in winter, such as deep pools in stream channels. Larvae require 2 to 4 years to metamorphose, and thus require water bodies which do not dry in summer (Knapp and Matthews 2000).

Once abundant in aquatic ecosystems of the mid to high elevation Sierra Nevada from southern Plumas County to southern Tulare County (Jennings and Hayes 1994), MYLF has undergone a range-wide decline in the Sierra Nevada (USDI Fish and Wildlife Service 2003). Over 90% of historically occupied sites in the Sierra Nevada are now unoccupied (Vredenburg et al. 2007). The decline of MYLF in the Sierra Nevada has largely been attributed to the introduction of salmonid fishes during the last century (USDI Fish and Wildlife Service 2003). More recently, the disease chytridiomycosis has emerged as a significant threat to the species (Briggs et al. 2005, Oullet et al. 2005, Wake and Vredenburg 2008). Additional reasons for the MYLF decline or contributing factors include airborne pesticides (Davidson et al. 2002, Davidson 2004, Davidson and Knapp 2007), loss of habitat, altered habitat, and grazing (USDI Fish and Wildlife Service 2003). Davidson and Knapp (2007) evaluated over 6800 sites in the southern Sierra Nevada comparing MYLF occupancy with presence of introduced fish, habitat conditions, and predicted exposure to airborne pesticides from agricultural lands upwind in California's Central Valley, and found that airborne pesticides appeared to have a pronounced negative effect on MYLF occupancy independent of the other factors examined.

MYLFs are known to have been present within a number of locations in Tahoe National Forest, but now exist in only a few populations in ponds and streams and generally in small numbers (USDI Fish and Wildlife Service 2003, Tahoe National Forest GIS database). Jennings and Hayes (1994) indicate that the species was extinct by 1992 in a number of locations based on re-surveys of historic locations. The Tahoe National Forest GIS database records show that since 1993 there have been MYLFs documented in 4 general localities on Truckee Ranger District, 6 general localities on Sierraville Ranger District, and 10 general localities on Yuba River Ranger District. Between 2000 and 2006, and in 2011, targeted amphibian surveys were conducted by Tahoe National Forest personnel within most drainages of the

Sagehen Project area; survey methods included pole-seining, and visual encounter. MYLF have been detected in Sagehen Basin within the project area. The analysis area for MYLFs will include all lentic and lotic waters within the aquatics analysis area for the Sagehen project, including riparian conservation areas.

Some treatment units for Alternative 1 and Alternative 3, are proposed within, and adjacent to areas containing suitable habitat for the MYLF. Suitable frog habitat was determined by designating known occupied habitat combined with a GIS analysis. The different types of frog habitat are depicted on Table 3.19 below.

Table 3.19: Frog Habitat within the Sagehen Aquatic Analysis Area		
Sub Watershed: Lower Sagehen	**RCA Type**	**Acres**
	Intermittent Stream	174.4
	Perennial Stream	291
	Spring	13
	Wetland	173.5
Sub Watershed: Upper Sagehen	Intermittent Stream	315.5
	Perennial Stream	313.6
	Spring	3.4
	Wetland	536.6
	Lake/Pond	14.4

Within the aquatics analysis area, there is an estimated **1,835.1** acres of suitable frog habitat. Under Alternative 1, approximately 373 (20.3%) acres of RCAs associated with frog habitat would be treated; under Alternative 3 approximately 241 (13.1%) acres of RCAs associated with frog habitat would be treated. Under Alternative 1, within the Upper Sagehen Catchment, there are nearly twice as many acres proposed than under Alternative 3. Treatments associated with perennial streams under both action alternatives are primarily treated manually, reducing risks to frogs and their habitat.

Direct and Indirect Effects

In general, MYLF is closely associated with water, however, juveniles have been observed moving away from water during dispersal from breeding habitats. Depending on local conditions, frogs are known to travel distances greater than 300 feet from perennial water sources. MYLF may use intermittent streams seasonally, or as migration corridors. During periods of drying, frogs may use rodent burrows or duff layers to retain moisture. Possible direct effects to frogs associated with the Sagehen project include: Temporary/road construction and obliteration, stream crossing construction, activities within RCAs, felling of trees, burning activities, use of water drafting sites, and the application of Sporax™.

Frog habitat has the potential to be indirectly affected by project activities. Stream survey data provides evidence that many stream reaches within the analysis area currently exhibit undesirable habitat characteristics such as unstable stream banks, moderate percentages of fine sediment, and low quantities of coarse woody debris. Stream bank stability and fine sediment

can be affected through heavy equipment use associated with mechanical thinning and road building. Coarse woody debris would be reduced resulting in a decrease in future log recruitment, reduced duff layers and a reduction in canopy cover. Standard management requirements and special RCA protection measures are in place, and implementation of the project is intended to maintain the function of the RCAs; however, there is a level of uncertainty associated with the operation of mechanical equipment within close proximity to stream channels. The location and treatments associated within RCAs have been considered, and it has been determined that there could be indirect effects to the stream channel condition, although the risk is considered low.

Effects to MYLF frog are minimized generally through project design features within RCA's (see RCO Analysis, Appendix D) as well as several SMR's designed to protect aquatic resources, including frogs (see SMR's, Appendix A). Specifically, SMR's #31 and #45 would protect MYLF through the following measures:

SMR 31

1. To reduce the potential of impacts to Sierra Nevada yellow-legged frog (MYLF) where sightings establish the presence of MYLF, implement the following management requirements: Within RCAs noted by the aquatics biologist as MYLF habitat or breeding areas, require no ground disturbing activities during the limited operating period (LOP) of November 30 to May 30. This LOP is needed to avoid possible interference with MYLF during a time when they may move away from stream courses.

2. To avoid impacts to MYLF, identify all drafting sites to be used, in conjunction with the proposed action, and report these to aquatics biologist, to allow the implementation of the following mitigation measures: Prior to use each year, water drafting sites where frog habitat is present, a survey will be conducted by an aquatics biologist to determine if frogs are present. If MYLF is found to be present, the biologist will determine whether water drafting mitigations measures are needed. Use of any water source on the Sale Area will be agreed to in writing. Drafting sites shall be located to minimize sediment and maintain riparian resources, channel condition, and MYLF habitat. Use suction strainers with screens less than 2 mm in size. Place draft suction strainer in a bucket to avoid substrate and amphibian disturbance. Draft from deepest water source, near bottom.

3. To prevent effects to MYLF consult the aquatics biologist about, or do not allow the use of foam during prescribed burning activities within RCAs.

4. Individuals have been sighted in areas associated with unit 61(Emphasis areas 1 &2), unit 91 (Emphasis area 2), and unit 213 (Emphasis areas 1, 2, 4, & 6). Units 61 & 91 are proposed for hand treatment. Hand treatment units will cut trees 14 inches dbh or less, and Sporax® would not be applied to stumps. Unit 213 has the potential to cut trees greater than 14 inches dbh, therefore Sporax® may be applied. An Aquatics biologist will

review areas within 500ft of occupied sites of MYLF to determine if application of Sporax® should be avoided.
5. *If wetting rain (>.25 inch) occurs during, or within two weeks prior to treatment, a biologist should survey treatment units and temporary roads within .25 mile of RCAs that may be used.* If species are present, determine appropriate mitigation measures to reduce the risk of direct effects to individuals.

SMR 45

Sierra Nevada yellow-legged frog Limited Operating Period (LOP): To reduce the potential of impacts to Sierra Nevada yellow-legged frog (MYLF), on stream in 80-8, add a 200 foot limited operating period (LOP) buffer to the standard Riparian Conservation Area (RCA). Within the combined RCA and LOP buffer, no ground disturbing activities would be permitted during the LOP of November 30 through May 30. This LOP is needed to avoid possible interference with MYLF during a time when they may move away from stream courses. To prevent effects to MYLF consult the aquatics biologist about, or do not allow the use of foam during prescribed burning activities within RCAs.

Although the above protection measures reduce the likelihood of impacts to MYLF, direct effects to individual frogs could occur from implementation of the Sagehen Project. There is the potential for frogs to be harmed if they are present during the time activities are occurring. Under Alternative 1, there are more activities occurring in RCAs (373 acres) than under Alternative 3 (241 acres), increasing the potential for interaction with frogs. Provided that the prescribed SMR's and project design features are properly implemented, direct and indirect effects from the Sagehen Project treatments should not significantly alter MYLF distribution or population size. Cumulative effects to MYLF are discussed later in Chapter 3 under FONSI Element #7.

Determination

Implementation of Alternative 1 or Alternative 3 may affect individuals of MYLF, *Rana sierrae,* but is not likely to result in a trend toward Federal listing or loss of viability for this species within the planning area of the Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of this species as discussed previously in this evaluation, and professional judgment.

GREAT BASIN RAMS-HORN SNAIL

Status: USFS R5 Sensitive

The Great Basin rams-horn snail (GBRHS) is listed as Sensitive on the Region 5 Forester's Sensitive Species List (USDA Forest Service 1998). Historically, GBRHS occurred in a highly restricted distribution but and were locally abundant. They have occurred within the lakes and larger, slow streams in and

around the northern Great Basin. In California the snail was known to occur in six local drainages in which the species probably survives in four of these drainages.

The GBRHS occurs in larger lakes and slow rivers including larger spring sources and spring-fed creeks. These snails characteristically burrow in soft mud and may be invisible even when abundant (Taylor 1981). Habitat requirements include cold highly oxygenated water, muddy substrate, and slow stream flow. Springs are preferred, but the snail will use river margins. Soft sediments are preferred. Threats to snails have been attributed to water diversions and water pollution. Mitigations for fish species, such as adding spawning gravels, may harm this species by smothering soft mud habitats. Changes to conditions which may be adverse to this species include but are not limited to habitat alteration, changes in water flow regime, changes in water quality and loss of hosts for development.

Historically, the GBRHS has been observed in the Truckee River directly downstream of Lake Tahoe, on the Lake Tahoe Basin Management Unit. This snail has not been sighted or surveyed for in the Tahoe National Forest. Suitable habitat occurs within slow segments of the Truckee and Little Truckee Rivers and their tributaries. This species has not been surveyed for in the project area. Extensive stream habitat and fish/amphibians surveys have been conducted between 2000 to 2011within suitable snail habitats, but no incidental sightings have been recorded. Some suitable habitat may exist within or near the project area in Sagehen Creek, its tributaries and associated springs.

Direct and Indirect Effects

No direct effects are expected as a result of project activities. There are no proposed treatments under any of the alternatives that would occur directly within perennial water bodies. Therefore, there would be no direct effects to GBRHS. There is a very slight chance of an increase in fine sediment input into snail habitat associated with the use of heavy equipment near stream channels, and the removal of conifer trees that are associated with the streams; however, it is highly unlikely that this would produce a negative effect on this species. It is unlikely that these effects will be detectable in areas of suitable habitat for this species due to a variety of SMR's (Appendix A) designed to protect RCAs, and the small quantity of units located near low gradient streams which serve as potential snail habitat.

Determination

Based on the analysis of potential effects to GBRHS from Alternative 1 and Alternative 3, the Sagehen Project will not affect the Great Basin rams-horn snail, *Helisoma newberryi newberryi*.

Management Indicator Species

The Tahoe National Forest LRMP as amended by the Sierra Nevada Forests Management Indicator Species Amendment (SNF MIS Amendment) Record of Decision (USDA, December, 2007) guides each project to provide the wildlife habitat and other ecological conditions necessary to maintain well-

distributed viable populations of Management Indicator Species (MIS) at the project area and bioregional scales and to maintain diversity of plants and animals . The Sagehen Project Terrestrial and Aquatic MIS Reports are summarized below and are incorporated by reference and available upon request. The aquatic MIS applicable to Project-Level MIS analysis for the Sagehen Project are aquatic macro invertebrates (lacustrine/riverine habitat), and Pacific tree frog (wet meadow habitat).

LACUSTRINE/RIVERINE HABITAT (AQUATIC MACROINVERTEBRATES)

Aquatic or Benthic Macroinvertebrates (BMI) were selected as the MIS for riverine and lacustrine habitat in the Sierra Nevada. They have been demonstrated to be very useful as indicators of water quality and aquatic habitat condition (Resh and Price 1984; Karr et al. 1986; Hughes and Larsen 1987; Resh and Rosenberg 1989). They are sensitive to changes in water chemistry, temperature, and physical habitat; aquatic factors of particular importance are: flow, sedimentation, and water surface shade.

Project-Level Effects

Stream flow**:** Stream flow would not be directly impacted by the project. Indirect effects from thinning the uplands, removing conifers from meadow margins and aspen stands include the possible reduction of transpiration and interception of precipitation. This reduction may indirectly affect the location of water storage within the system and may manifest in an increase of soil moisture, understory productivity, runoff, and/or stream base flow when soil water is not limited. The effect will vary each year depending on weather. The magnitude of effects would be such that existing water table and flow patterns will most likely be maintained at current conditions under all alternatives.

Sedimentation: The risk of impacts to streams and aquatic habitats from changes to sediment character is related to the proximity of skid trails, landings and temporary roads to streams and riparian habitats, slope gradient, soil stability, extent of ground disturbance, size of material removed, and the management requirements and mitigations that are implemented. Thinning using a mechanical harvester to cut trees, and the use of tracked or rubber tired skidders to move material to a landing has potential to increase sediment movement. The project design includes manual treatments within many RCA units to minimize potential impacts from equipment use (see Chapter 2 and Appendix D).

Under Alternative 1 there are approximately 271 acres of mechanical silvicultural treatment in RCA's and 128 acres under Alternative 3. Within the RCA, areas of decreased infiltration and decreased ground cover could result in heavily tracked areas across mechanical treatment units. Assuming proper implementation of the SMRs 4, 5 and 7, and with no landings placed within RCAs (SMR 11), high compaction areas within the RCA would be minimized. The potential for sediment transport and runoff are also decreased through providing drainage controls and mulching as described in SMRs 2, 9, 17 and 23.

Alternative 1 includes approximately 3.8 miles of temporary roads with approximately 5.5 acres of disturbance over the project area. . It should be noted that temporary roads as currently

mapped are close approximate locations. However, final locations will consider hydrology, slope, soil, and sensitive area restrictions, and will be located in the best available site that maintains water resources and beneficial use. Short segments of mapped temporary roads would cross through RCA areas. There are an estimated 0.27 miles of temporary road through 150 foot RCA buffers on seasonal streams in units 33, 36, 73, and 163. The 0.06 miles in perennial RCA falls within unit 163 at the very upper perimeter of the 300 foot RCA around a stream flowing from a perennial spring. The 0.26 miles in meadow RCAs includes approximately 0.1 miles in unit 163 at the very upper perimeter of the 300 foot RCA around the meadow system supported by the perennial spring. The remaining 0.16 miles is located in the upper end of unit 33 where the RCA is associated with a meadow, however this temporary road, while still in the 300 foot RCA, is located in an upland, dry site. Overall, effects in these RCAs from temporary roads are expected to be minimal because the roads will be located in the best available site and the design features will protect resources. The mitigations associated with temporary roads are included in SMRs (19, 20, 21 and 22, Appendix A) and incorporate standard temporary road BMPs. In addition, there would be a closure on the temporary road in unit 163 which will preclude access when the road is not being used for project activities. At the end of project use, these temporary roads would be sub-soiled and obliterated, and mulch and organic matter would be re-incorporated into the surface soils.

A variety of protection measures including tractor keep-out area provisions and stream crossing mitigations would minimize mechanical equipment impacts on sediment production. A number of restrictions also prevent the removal of trees in RCAs under certain situations (soil type, slope, designated retention trees). For a complete list of management requirements and resource protection measures, refer to Appendix A of the EA.

Because treatments under Alternative 1 and 3 are similar, the fewer acres within RCAs under Alternative 3 would result in fewer acres with changed sediment character. Because no temporary roads will be constructed under Alternative 3, there is no increased risk of sediment transport from temporary roads under this alternative. Under both Alternative 1 and Alternative 3, changes to sediment production are expected to be negligible. Under Alternative 2, the no-action alternative, no treatments or activities would be implemented and the character of sediment would not change beyond existing trends.

Shade**:** Shade to the stream channels is predominately associated with an east side pine or east side mixed conifer ecotype, with isolated sections of aspen, alder and willow over story. Perennial stream reaches associated with the Sagehen Project are primarily being treated manually. Most of the seasonal drainages within the Sagehen Project area are ephemeral and because these habitats are ephemeral they do not contain water long enough for shade and stream temperature to affect the aquatic resources when stream temperatures are limiting. Perennial springs and streams are heavily influenced by groundwater and there is a continued flux of inputs from these sources from various locations in the basin. The silvicultural treatment

under Alternatives 1 and 3 would remove some of the existing conifers. This would result in a net reduction of potential shade to the stream channels and flood plains.

Under Alternative 1, the management objective of emphasis areas 2 and 4, which contain most of the RCA's and the major stream channels within treatment units, is to retain higher canopy cover, fuel moistures, and more snags and logs than the surrounding forest. These emphasis areas are designed to leave high basal area, encouraging continued shade to stream channels. At site-specific locations throughout both emphasis areas, some areas would not be treated, therefore not changing tree density. The high basal area of the treated areas, in combination with the untreated areas, would leave considerable trees within 125 feet of the water bodies that would provide shade. Emphasis area 8 is associated with aspen restoration, and in these sites the objective in this emphasis area is to minimize direct conifer competition to existing aspens and to remove conifers to the extent that the aspen stand could expand based on site conditions. As the extent of this area is small (6 acres), with 5 acres limited in the size of tree that would be treated by hand, the results are not expected to negatively affect shade. In addition, aspen have a high turnover rate and are also expected to contribute to the level of shade associated with the stream and flood plain.

Under Alternative 3, fewer acres would be treated in RCA's and adjacent to stream channels and most acres in those areas would be treated manually. The majority of these acres lie in plantations that are primarily seasonal drainages. Adequate numbers of trees are made available to shade the channel with an average spacing of 14 to 22 feet distance as the designed prescription under this action alternative. Alternative 3 would have higher canopy cover than Alternative 1 because of less treated acres in general and less mechanically treated acres.

A variety of protection measures including tractor keep-out provisions would prevent mechanical equipment from at least 25 feet from streambanks, and a number of restrictions (Appendix A, SMRs 3, 4, 5, 39 and 40) would prevent the removal of trees in RCAs under several situations (soil type, slope, designated retention trees) . Although it is predicted that with proper implementation of SMRs the effects of shade would be negligible under Alternative 1 and Alternative 3, Alternative 3 appears to have a lower risk to the reduction of shade since it has less treatments within RCAs.

Aquatic Macroinvertebrate Status and Trend at the Bioregional Scale

The Tahoe NF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale Index of Biological Integrity and Habitat monitoring for aquatic macroinvertebrates; hence, the lacustrine and riverine effects analysis for the Sagehen Project must be informed by these monitoring data. The sections below summarize the Biological Integrity and Habitat status and trend data for aquatic macroinvertebrates. This information is drawn from the detailed information on habitat and population trends in the 2010 Sierra Nevada Forests Bioregional MIS Report (USDA Forest Service 2010a), which is hereby incorporated by reference.

Sierra Nevada MIS monitoring for aquatic (benthic) macroinvertebrates (BMI) was conducted in 2009 and 2010 (Furnish 2010). Benthic macroinvertebrates were collected from stream sites during both the

2009 and 2010 field seasons according to the Reachwide Benthos (Multihabitat) Procedure (Ode 2007). The initial BMI data from 2009 and 2010 found 46% (6 of 13) of the surveyed streams indicate an impaired condition and 54% (7 of 13) indicate a non-impaired condition (see USDA Forest Service 2010a, Table BMI-1). This is similar to the IBI conditions estimated by Moyle and Randall (1996). Therefore, current data from the Sierra Nevada indicate that status and trend in the RIVPACS scores appears to be stable.

As discussed above, the changes in flow, sedimentation, and shade resulting from the Sagehen Project are too small to be measured, and will not alter the existing trend in the habitat or aquatic macroinvertebrates across the Sierra Nevada bioregion.

WET MEADOW HABITAT (PACIFIC TREE FROG)

The Pacific tree frog (now known as the Pacific chorus frog) was selected as an MIS for wet meadow habitat in the Sierra Nevada. This broadly distributed species requires standing water for breeding; tadpoles require standing water for periods long enough to compete aquatic development, which can be as long as 3 or more months at high elevations in the Sierra Nevada (CDFG 2005). During the day in the breeding season, adults take cover under clumps of vegetation and surface objects near water; during the remainder of the year, they leave their breeding sites and seek cover in moist niches in buildings, wells, rotting logs or burrows (ibid).

Project-Level Effects

There is an estimated 1,835 acres of frog habitat within the analysis area. GIS was queried for lake and pond habitat, along with wet meadow habitat and AQB soil types. Under Alt. 1, 373 acres of RCAs associated with frog habitat would be treated; under Alt. 3 approximately 230 acres of RCAs associated with frog habitat would be treated. Under Alternative 2, zero acres would be treated. It should be noted here that meadow/spring/fen feature acreages are overestimated because GIS incorporates both treated and untreated lands associated with the features in most cases. The meadow habitats within the analysis area vary in quality, and not all acreages displayed have pond habitat suitable for breeding. The best breeding and rearing habitats identified in this analysis do not have treatments associated with them under any alternatives. Since no treatments occur under Alternative 2, no effects are anticipated under that alternative beyond existing trends.

The Sagehen Project has the potential to directly and indirectly affect frog habitat with road construction, stream crossing construction, mechanical treatment and burning activities within RCAs. Under Alternative 1, there are more activities occurring in RCAs than under Alternative 3, increasing the potential for direct and indirect effects to frog habitat. An array of features was designed for both action alternatives to prevent and reduce effects to suitable stream miles and riparian habitat. The silvicultural treatment in Riparian Conservation Areas(RCAs) are largely under Emphasis Areas 2 and 4 treatment design, in which high basal area would be retained, select areas would remain untreated , and microclimatic variability would be encouraged. While a total of 373 acres of frog habitat RCA would be treated Alternative 1, 184 acres are designated to receive manual treatment (rather than mechanical)

to reduce effects to streambank stability or sediment generation from heavy equipment. Under Alternative 3, a total of 241 RCA acres would be treated with 179 acres designated for manual treatment. Under both alternatives a standard 25-foot equipment exclusion zone from riparian areas would be implemented in mechanical treatment areas, and SMR 7 would require the aquatics biologist or hydrologist to design specialized exclusion zones for complex riparian areas. Although these protective measures (among others, Appendix A) would largely prevent effects from the action alternatives there remains a risk for effects.

With the removal of conifer trees near drainages, there is the potential for:

Indirect effects to the stability of stream banks: Effects could result from the removal of trees within the RCAs in the area between the standard 25-foot equipment exclusion zone (TKO) to the area of concern 50-feet from the waterway. Heavy equipment operating within these areas has the potential to compact soils and affect surface run-off. Under Alternative 1, mechanical treatment on 189 acres in frog habitat RCA could affect streambank stability, compared to 62 acres under Alternative 3.

Potential changes to the character of sediment: Effects from mechanical treatment and temporary road use may occur. Within the RCA, areas of decreased infiltration and decreased ground cover could occur in heavily tracked areas across mechanical treatment units. Assuming proper implementation of the SMRs 4, 5 and 7, and with no landings placed within RCAs (SMR 11), high compaction areas within the RCA would be minimized. The potential for sediment transport and runoff are also decreased through providing drainage controls and mulching as described in SMRs 2, 9, 17 and 23. Under Alternative 3 there is a total 62 acres proposed mechanical treatment in frog habitat RCA areas. Under Alternative 1, short segments of temporary roads would cross through RCA's. At the end of project use, these roads would be sub-soiled and obliterated, and mulch and organic matter would be re-incorporated into the surface soils. Because no temporary roads will be constructed under Alternative 3, there is no increased risk of sediment transport from temporary roads under that alternative.

A decrease of coarse woody debris recruitment: Effects from the removal of trees within 125 feet of waterbodies. Alternative 1 has incorporated characteristics into site specific design for the activity areas associated with emphasis areas 2 and 4. These emphasis areas are designed to leave high basal area, encouraging future woody debris recruitment. The primary difference between the alternatives is that fewer acres of RCA would be treated under Alternative 3 and most of this would be treated manually. Because of the greater area of treated units, risks for impacts are slightly higher under Alternative 1 than Alternative 3. However, if project design features and SMR's (Appendix A) are properly implemented, effects from the treatment should not significantly alter Pacific Tree Frog habitat.

Pacific Tree Frog Status and Trend at the Bioregional Scale

The Tahoe NF LRMP (as amended by the SNF MIS Amendment) requires bioregional-scale habitat and distribution population monitoring for the Pacific tree frog; hence, the wet meadow effects analysis for the Sagehen Project must be informed by both habitat and distribution population monitoring data. The sections below summarize the habitat and distribution population status and trend data for the Pacific tree frog. This information is drawn from the detailed information on habitat and population trends in the SNF Bioregional MIS Report (USDA Forest Service 2008), which is hereby incorporated by reference.

There are currently 66,000 acres of wet meadow habitat on National Forest System lands in the Sierra Nevada. Within the last decade, the trend is stable. Since 2002, the Pacific tree frog has been monitored on the Sierra Nevada forests as part of the Sierra Nevada Forest Plan Amendment (SNFPA) monitoring plan (USDA Forest Service 2006, Brown 2008). These data indicate that Pacific tree frog continues to be present at these sample sites, and that the distribution of Pacific tree frog populations in the Sierra Nevada is stable.

Within the Sagehen wet meadow habitat analysis area, there are approximately 1,835 acres of wet meadow and frog habitat identified. Changes to the wet meadow habitat will likely vary across the analysis area. These changes will not alter the existing trend in the habitat, nor will it lead to a change in the distribution of Pacific tree frogs across the Sierra Nevada bioregion.

Plants

This section of the EA analyzes the direct and indirect effects of the alternatives to USDA Forest Service Region 5 Forester's Sensitive Plant Species (Forest Service sensitive: June 8, 1998; updated April 21, 2004 and July, 2006). The following analysis is based upon the Sagehen Project Biological Evaluation for plants and fungi (October, 2012), hereby incorporated by reference. The full report is part of the project record on file with the Tahoe National Forest and available upon request.

Affected Vegetation Communities in the Sagehen Basin

The plant communities present within the Sagehen Project area are primarily forested by eastside pine, and white fir mixed conifer forests, lodgepole pine, red fir and white fir stands. These forested plant communities include Jeffrey pine, white fir, red fir, western white pine and lodgepole pine. Aspen has been found to occur in a few stands in the northwestern portion of the project area. Common shrubs include greenleaf manzanita, snowberry, snowbrush, whitethorn, and gooseberry. Sagehen Creek runs through the Sagehen Project area as do many perennial and intermittent streams that support riparian vegetation including willows, mountain alder and numerous herbaceous species of grasses and grass-like plants. The majority of the riparian vegetation occurs within fens which typically occur along many of the north-facing tributaries to Sagehen Creek. Sagehen Basin has been known for having a high concentration of fens of many sizes and shapes. Fens are peat-forming wetlands that rely on groundwater input and require thousands of years to develop and cannot easily be restored once destroyed (Weixelman and Cooper, 2009). These fens harbor a high diversity of plant and fungi species, including several listed as Forest Service sensitive. Approximately 53 acres of fens occur within the

Sagehen Basin, of those, nine acres occur within units proposed for treatment under Alterative 1 and Alternative 3. That leaves about 44 acres (83 percent) of the fen area that would remain outside any units that have proposed treatments within the Sagehen Basin.
The following Forest Service sensitive plant and fungi species are known to occur or assumed to occur within or adjacent to the Sagehen Project Area: *Botrychium ascendens, Botrychium crenulatum, Botrychium lunaria, Botrychium minganense, Botrychium montanum, Bruchia bolanderi, Cudonia monticola, Ivesia sericoleuca, Meesia triquetra, and Meesia uliginosa.*

Direct and Indirect Effects to Sensitive Plant and Fungi Species

Alternatives 1 and 3 (Action Alternatives)

Direct and indirect effects to sensitive plant and fungi species as a result of the Sagehen project action alternatives are expected to be limited in extent and intensity because approximately 80 percent of the sensitive plant and fungi habitat occurs outside of proposed treatment units. Impacts to sensitive habitat would be further minimized by the use of flag and avoid mitigation measures and implementation of other Standard Management Requirements (SMR's) for sensitive plants as shown in Appendix A. Most of the sensitive plant and fungi habitat is concentrated within riparian areas on the project. Vegetation treatments for riparian areas were suggested by GTR 220 and informed the development of treatments for emphasis areas 2 and 4. Emphasis areas 2 and 4 include perennial stream courses and other intermittent and ephemeral drainages throughout the Basin. The treatments in these emphasis areas would minimize disturbance of riparian vegetation and soils by implementing no treatment or using hand methods in the most sensitive areas, maintaining higher tree densities along perennial streams, restricting pile locations, restricting equipment use, and requiring underburning at lower intensities. Alternative 1 would have greater potential for direct and indirect effects to sensitive plants and fungi than Alternative 3 because Alternative 1 would treat more acres across more treatment units than Alternative 3. See Chapter 2 of the EA and Appendix B (Maps) for detailed descriptions of the alternatives.

Alternative 2 (No Action)

There would be no direct effects to any Forest Service sensitive plant or fungi species under Alternative 2. Ongoing activities in the project area would continue to be managed according to current Forest Plan direction. Indirect effects under Alternative 2, include continuing and increasing risk of high intensity wildfire, insect infestations and disease outbreaks over time as stand densities and fuel loadings increase (Ferguson, 2012). High intensity wildfires could affect any one or all of the sensitive species with known or assumed occurrences within or adjacent to the project area. Fire suppression activities prompted by a major wildfire in the Sagehen Basin could also affect sensitive plant and fungi species.

Air Quality

The following section of the EA summarizes effects on air quality from the Sagehen Project alternatives based on the analysis contained in the project Air Quality report (December, 2012) hereby incorporated

by reference and available upon request. The Sagehen Project Area is located in Sierra County, California. Nearby towns, communities, and highways are shown in Table 3.20 below.

Table 3.20: Towns, communities and highways in the vicinity of the Sagehen Project

Town or Feature	Distance and Direction from Sagehen Project Boundary
Highway 89	1 mile west
Truckee	6 miles south
Sierraville	10 miles northwest
Loyalton	17 miles northwest

The entire project area is contained in the Northern Sierra Air Quality Management District (NSAQMD) within the Mountain Counties Air Basin. Air quality in the context of this document refers to the amount and type of emissions contained in smoke produced by prescribed burning and wildfires. Air emissions concerns in the Sagehen Project area include inhalable particulate matter (PM_{10}), ozone (modeled as NOx) and carbon dioxide (CO_2). Ozone production varies significantly with changing atmospheric conditions and models are not available to predict ozone formation resulting from project emissions. Instead, emissions of the ozone precursor Nitrogen Oxides (NOx) were modeled to predict the effects of the project alternatives. Fugitive dust caused by equipment use and vehicle travel on unpaved roads can produce PM_{10} in quantities great enough to impair the visual quality of the air. These effects are localized and can be mitigated by effective dust abatement methods. Dust generated by skidding, loading, and timber harvest activities also contributes to fugitive dust; however, the level contributed by these activities is unknown.

The Sagehen Project has been determined to conform to the Clean Air Act and the State Implementation Plan (SIP). All the predicted emissions are less than the conformity thresholds. Prescribed fire smoke emissions, and similar activities like pile burning, are included in an approved Smoke Management Program (SMP) and are therefore presumed to conform to the SIP.

Prescribed underburning, pile burning, and project implementation: Under Alternative 1, 2560 acres would undergo prescribed fire treatments such as underburning, grapple pile burning, hand pile burning and the burning of large landings which would be implemented over a 10-year period. Each year the burning would take place over a period of months, with treated areas spread throughout the project area. Prescribed fire would be implemented in the spring, fall, or winter months which are the best times of year for emissions dispersion. Emissions from mechanical equipment and roadwork were calculated for a total of 2,169 acres, also distributed over a 10-year period. The emissions from underburning, pile burning and project implementation for Alternatives 1 and 3 are discussed in greater detail in the Air Quality Report.

Under Alternative 2 (No Action), no increase in ozone precursors and PM10 emission levels would be produced from prescribed burning of activity-generated fuels, harvest operations, or understory burning, since these activities would not occur. Alternative 2 would not result in a reduction of surface fuels, so the potential for substantial degradation of air quality from future wildfire would not be

reduced as it would be under the other alternatives. Air quality can be severely impacted by particulate matter and other pollutants during large wildfire events

Under Alternative 3, a total of 1,344 acres proposed for prescribed fire treatment were analyzed and the projected time to accomplish prescribed burning would be approximately 10 years. Emissions from mechanical equipment and roadwork were also calculated for a total of 757 acres, which would take approximately 10 years to finish the project.

***Fugitive Dust*:** Under Alternative 1 and Alternative 3, fugitive dust could be caused by equipment use and vehicle travel over unpaved roads. Because of the large size of the Sagehen Project area, the small amount and dispersed nature of dust producing activities, and the favorable weather conditions within the normal operating season, in combinations with the dust abatement techniques used, any adverse effects from dust are expected to be minimal. Since more potentially dust causing activities are implemented under Alternative 1 than under Alternative 3, the risk for fugitive dust is slightly higher under Alternative 1. No dust producing activities are proposed under Alternative 2.

***Greenhouse Gas Emissions*:** For this analysis the emissions from planned activities under Alternative 1 and Alternative 3 must be compared against the CO2 emissions that could occur with an unplanned wildfire, which, as Safford et al. (2012) conclude, is more likely to occur lacking vegetation treatments which reduce hazardous fuel loading. A synthesis study by Safford et al. (2012) showed that tree mortality rates in treated areas that burned in wildfire were generally much lower than in neighboring untreated forest (mean of 22% vs. 73%). Thus, completed treatments notably sustained a forest's ability to continue to sequester carbon, a result consistent with modeling and post-fire assessments of forest carbon (Hurteau and North, 2010; North and Hurteau, 2011). Less tree carbon loss following wildfire must be viewed in the context of the carbon sequestered from biomass and saw timber removal in treated areas before they encountered fire. The ultimate use of that removed biomass results in relatively long-term sequestration in building materials, and biomass burning for energy which supplants fossil fuels.

Mixed conifer and yellow pine (eastside pine type) forests in California supported tremendous amounts of fire before the arrival of Euroamerican settlers (Sugihara et al., 2006; Stephens et al., 2007; van de Water and Safford, 2011). Although most of that fire is generally understood to have been of lower severity, such a relationship with fire – especially when combined with projected increases in the inertia for fire as climates continue to warm –suggests that these forest types should not be focus areas for grand schemes to increase US carbon sequestration rates. Rather, in these forest types it makes sense to focus on management practices that restore fire- and drought-resilient forest structures that are more likely to retain tree carbon through recurrent fire (and other disturbance) cycles (Hurteau and North, 2009). Such practices, which focus on the recruitment and retention of large, fire-tolerant trees, include forest thinning of smaller individuals of more fire-sensitive species (with the removed biomass used wisely), prescribed burning, and an expansion of the use of naturally-ignited wildfire.

In comparing CO2 emissions potential across the Alternatives, a 5,000 acre wildfire fire was assumed for Alternative 2, as that scenario would be more likely lacking prescribed vegetation treatments proposed

under Alternative 1 and Alternative 3. Table 3.21 below shows that CO2 emissions resulting from a potential wildfire under Alternative 2 would be several times higher than for either of the Action Alternatives which reduce hazardous fuels.

Table 3.21: Comparison of emission outputs for all alternatives including a possible 5,000 acre wildfire for Alternative 2

	Acres	CO2 (tons)
Alt. 1	2,620	599.5
Alt. 2 w/ 5,000 acre wildfire	5,000	7,000
Alt. 3	1,344	393.6

Mitigation Measures for Alternative 1 and Alternative 3: Under both Alternative 1 and Alternative 3, proper mitigation measures to meet air quality requirements would be implemented by the Sagehen Project. During the implementation of the Action Alternatives, the prescribed fire planner would coordinate with the Air Quality Coordinator to design the smoke management plan. Burning permits would be acquired from the Northern Sierra Air Quality Management District. The Air Quality District would determine days when burning are allowed. The California Air Resources Board (CARB) provides daily information on "burn" or "no burn" conditions. Burn plans would be designed and all fuel reduction burning would be implemented in a way to minimize particulate emissions. Prescribed fire implementation would coordinate daily and seasonally with other burning permittees both inside and outside the forest boundary to help meet air quality standards. The local communities that might potentially be impacted by prescribed fire smoke from the Sagehen Project are Truckee and the surrounding vicinity of the southwest Sierra Valley. However, normal wind patterns will be carrying smoke to the northeast where communities and towns will not be impacted. Under favorable smoke-dispersal conditions, the smoke from the prescribed burning would likely affect air quality during ignition and for approximately one to three days following ignition. Because of the mitigations measures applied (SMR 38), the coordination with the CARB, any impacts are expected to be minimal. Dust abatement techniques would be applied as necessary to all these activities to minimize unsafe conditions and meet air quality requirements. The primary technique used for dust abatement is the application of water during operations

Recreation

The Sagehen Basin has limited recreation facilities and typically receives low to moderate intensity recreational use. Sagehen Campground is the primary recreation attraction in the area. It is relatively small at about three acres in size and has ten sites that rarely fill to capacity. The only other developed recreation facilities in the area are the Forest Service maintained Level II roads which receive moderate to low OHV use during spring, summer and fall. Dispersed recreation opportunities in the area include

hunting and fishing. Under Alternative 2 (No Action), no direct or indirect effects to recreation resources would occur beyond existing trends; effects under this alternative are not discussed further.

Direct and Indirect Effects under Alternative 1 and Alternative 3

Alternative 1 proposes a mechanical treatment method and surface fire and underburn in units 89 and 90. These units are adjacent to Sagehen Campground. Direct effects include an increase in noise and dust during mechanical treatment operations and an increase in smoke during periods of surface fire and underburn operations. Surface fire and underburning would likely occur during spring or fall. Sagehen Campground typically receives minimal use during those times. All operations in units 89 and 90 could have a negative visual effect for those camping at Sagehen Campground during implementation and immediately after prescribed burning. Under Alternative 3, no treatments would occur adjacent to Sagehen Campground so effects are not anticipated.

Alternative 1 proposes that Forest System Roads 89-36-10 and 89-36-12 receive pre-haul maintenance. This, most likely, would improve and widen these roads allowing for easier OHV travel when roads are open for public use. Alternative 1 also proposes that Forest System Road 11-5 be decommissioned after harvest activity. This action would minimally reduce OHV opportunity in the area as less than one mile of this road is proposed for decommissioning. Forest System Road 11-5 currently receives low OHV use. During project implementation under both Alternative 1 and Alternative 3 transportation of equipment and/or logs on the road system would temporarily increase traffic on the roads; however, the roads would remain open to public use and impacts to OHV users would be small. There would be more equipment traffic under Alternative 1 than Alternative 3 because of the greater scope of activities.

Economics

The purpose of this section is to summarize the economics analysis and compare the economic impacts of the three alternatives (the Proposed Action, No Action, and Non-Commercial Funding Alternatives) identified in this EA. The Sagehen Project is located within Nevada County on the Truckee Ranger District in the Tahoe National Forest and in close proximity to Sierra County. The economies of both counties would be affected by the Sagehen Project with the communities of Truckee, Sierraville, Calpine and Loyalton likely to be most influenced. Vegetation management projects, such as Sagehen, can create and sustain jobs in the local economies while stimulating the timber industry that the Forest Service requires to accomplish projects. Although, a vegetation project may have a small effect, relative to the larger national job market; effects to the local economy can be substantial. Vegetation management projects can provide lumber for mills, as well as work for the contractors extracting resources and implementing the myriad of other activities required by the contracts. Without this relatively consistent support, the local vegetation management workforce needed to implement prescriptions on our dynamic forest system will decline. Maintaining the infrastructure for logging and wood product processing is essential in allowing the Forest Service to meet multiple forest resource objectives.

Alternative 1

Alternative 1 would produce approximately 6.2 million board feet of timber and over 26 green tons of biomass with potential revenues of up to $2.8 million. Table 3.22 below displays total estimated service work costs from the various prescriptions, total product value and total project cost.

Table 3.22: Alternative 1 Project Cost

Total Service Work Cost	Total Product Value	Total Project Cost
$3,536,871	$2,760,476	**$776,395**

The Truckee Ranger District expects to have approximately $750,000 available over the next five years to implement the project through service contracts and force account work, so the project cost is roughly in-line with projected funding.

When measured directly, Alternative 1 is expected to create almost 50 jobs from the product alone. Alternative 1 service work will most likely create an additional 82 jobs. Therefore, if the proposed action is implemented, about 132 jobs will be created as a direct result from the work planned. Further, these jobs are anticipated to "generate demand for other goods and services as inputs to production" (SNFPA FEIS, 2004). As a result, indirect influences on local employment may create an additional 248 jobs for a total of up to 380 jobs created under Alternative 1.

Alternative 2

Under Alternative 2, none of the activities proposed under Alternative 1 or Alternative 3 would be implemented. Without any service work performed within the Project Area, there will be no direct cost to the government. Without product removal, there will also be no revenue generated. Without service work performed or product removal, no jobs will be created if there is no action within the Project Area.

Alternative 3

Alternative 3 will produce approximately 1.4 million board feet of timber and over 6,500 green tons of biomass with anticipated revenues of approximately $600,000. Table 3.23 below displays total estimated service work costs from the various prescriptions, total product value and total project cost

Table 3.23: Alternative 3 Project Cost

Total Service Work Cost	Total Product Value	Total Project Cost
$1,360,907	$600,023	**$760,884**

As discussed earlier, The Truckee Ranger District has approximately $750,000 available for vegetation treatment through contracts and force account work over the next 5 years. Therefore, Alternative 3 project cost is in-line with projected funding.

When measured directly, Alternative 3 is expected to create almost 11 jobs from the product alone. Alternative 3 service work will most likely create an additional 32 jobs. Therefore, if the Non-

Commercial Funding Alternative is implemented, about 43 jobs will be created as a direct result from the work planned. Further, these jobs are anticipated to "generate demand for other goods and services as inputs to production" (SNFPA FEIS, 2004). As a result, indirect influences on local employment may create an additional 80 jobs for a total of up to 123 jobs created under Alternative 3.

Cultural Resources

Potential effects to cultural and historic resources resulting from the Sagehen Project Alternatives were considered in preparation of this EA. See FONSI Element 3 and FONSI Element 8 for the description of potential effects to cultural and historic resources.

Element 2. The degree to which the proposed action affects public health or safety (40 CFR 1508.27(b)(2)).

The following discussion examines the risk to workers and the public from proposed activities in the Sagehen project. Hand (manual), mechanical, prescribed fire treatments, and application of fungicide (Sporax) all pose some risk to human health and safety.

A Human Health and Safety and Ecological Risk Evaluation for Borax Stump Treatment to prevent spread of annosus root disease is included as an attachment to the Sagehen Project Forest Vegetation Analysis. It is incorporated by reference and available upon request. It fully describes the potential risks to human health and safety for the use of Borax in the Sagehen Project.

Alternative 1 (Proposed Action) and Alternative 3 (Non-Commercial Funding)

Mechanical Equipment

Equipment operators can be injured in several ways. Operators can lose control of machines on steep or slippery terrain; however, such accidents are uncommon among experienced operators. Accidents can occur when operators push brush where visibility is poor, a short headwall or road-cut is encountered, or slope steepness or traction is misjudged. A machine that is out of control can roll over its operator or create hazardous flying debris. Operators can also suffer hearing damage.

Other workers are at risk of being struck by falling trees or pieces of wood or rock thrown out by the equipment, especially during tree cutting and mastication operations. Working on large machines that are slippery from oil or are otherwise hazardous also can cause injuries. Workers other than operators are also at risk of damaged hearing.

Risks to the public from use of mechanical equipment should be negligible. Injuries are possible from accidents when the equipment is being moved on public roads or in rare situations when a member of the public ignores safety warnings and enters a treatment area while equipment is operating.

Prescribed Burning

Burning creates risk of smoke and heat injury to both workers and the public. Effects on workers range from eye irritation, coughing, and shortness of breath to severe burns that can leave permanent scars or lead to mortality. In addition, chronic exposure of workers to smoke can lead to long-term adverse health effects, such as emphysema or lung cancer.

Smoke may have local, transitory effects on air quality. Sensitive members of the public may experience irritations of the eye, throat, or lung from even the low-level exposures. Risk of adverse chronic health effects on the public from smoke exposure should be lower than risks to workers, because public exposures would be much less than worker exposures.

Prescribed burns may "escape" (burn outside intend areas) and endanger the public. To reduce risks of burn "escapes" and other adverse effects, the Forest Service imposes special requirements for planning and implementing prescribed burns. All prescribed burn projects require preparation of a burn plan, which includes a burning prescription identifying requisite fuel and weather conditions for ignition, burning procedures, and safeguards. Safeguards are precautions needed to confine the burn to the prescribed area. In addition, the Forest Service has established qualification standards and training requirements for personnel involved in prescribed burning.

Hand Methods

Working with hand tools on steep slopes, and/or unfavorable site conditions is inherently hazardous. Conditions are highly variable, ranging from gentle slopes with vegetation densities to steep slopes with dense tall shrubs or trees. Extremely hot or cold ambient temperatures can occur depending on the time of year. Workers could be cut by tools, struck by falling shrubs or trees, or injured by falling onto sharp stumps or shrub stems. Risk of injuries increases with the amount of work, and are exacerbated when workers are concentrated in areas or fatigued. Injuries can result from minor cuts, sprains, bruises, and abrasions to severe injuries causing major arterial bleeding, compound bone fractures, brain concussions, or mortality.

Hand clearing of vegetation is relatively slow work, with production rates of 2-4 workdays/acre. This exposes workers to the hazards for longer periods in relation to other, more efficient methods of clearing vegetation. Risk of injuries increase as slope, vegetation density, and vegetation height increase.

Other adverse health effects associated with outdoor work in rugged terrain are possible. Examples are extreme fatigue, heat exhaustion or heat stroke, and exacerbation of chronic health conditions.

Proper supervision and effective training for safe use of hand equipment can reduce risks of worker injury. Wearing boots with non-skid soles and snag-resistant long-sleeve shirts and trousers can also reduce risks. Forest Service procedures and normal forestry worker practices involve use of these common safety practices.

Members of the public would not be expected to be at risk from the use of hand methods, because they are not likely to be sufficiently close to work.

Fungicide Use

Evidence indicates that workers who apply borax to cut stumps are not at risk of adverse effects due to boron exposure (Dost et. al, 1996 p. 61). Boron is excreted very rapidly without change by humans and other species, regardless of the route of intake (Dost et. al, 1996 p. 57). Dost et.al conclude that due to the limited routes of borax exposure to forestry workers and forest users, coupled with very little absorption through the skin, any doses incurred are expected to be inconsequential to human health and safety (Dost et. al, 1996 p.59).

Alternative 2 (No Action)
Alternative 2 would have no direct effects on human health because no operation of mechanical equipment, application of Sporax, hand treatment, or prescribed fire would occur in relation to this project. However, if a wildfire occurs in the project area without fuel treatments, severe wildfire behavior could result in significant adverse indirect and cumulative effects to the health and safety of the public and fire suppression personnel.

Element 3. Unique characteristics of the geographic area, such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas (40 CFR 1508.27(b)(3)).

There are no park lands or prime farmlands within or nearby the Sagehen Project Area; hence, these resources would not be affected by the proposed action. The Project Area has been surveyed and analyzed for cultural resources. Results of this work indicate that the proposed action would not affect any cultural resources eligible for the National Register of Historic Places, nor would it cause the loss or destruction of any significant cultural resources; cultural resources within the project area are discussed in more detail under FONSI Element 8 later in Chapter 3. The project area does include the unique characteristics of wetlands, a recommended Wild and Scenic river, and an Experimental Forest. Project design features and mitigation measures maintain the integrity of the unique characteristics located within and adjacent to the project area as described below.

Experimental Forest

In November, 2005 the 8,100 acre Sagehen Experimental Forest was designated under the administration of the USDA Forest Service Pacific Southwest Research Station (PSW) and the Tahoe National Forest. The Experimental Forest designation built on over 50 years of cooperative research involving the University of California, Berkeley, the Tahoe National Forest and PSW and took the partnership to a new level.

The primary purpose of an Experimental Forest is to provide opportunities for research to address a wide variety of ecological questions in forest settings including response of forest systems to land management practices. Sagehen is managed under direction of the Tahoe National Forest Land and Resource Management Plan (1990), as amended. The Experimental Forest includes the Sagehen Creek Field Station that has been operated by the University of California, Berkeley under special use permit from the Tahoe National Forest since 1951. Sagehen received designation as an Experimental Forest because of the area's ecological diversity as well as for the longstanding history of partnership in scientific research and forest data collection focused there. The inclusion of the Experimental Forest in the Sagehen Project Area will give researchers from numerous institutions an ideal opportunity to study

the effects of various vegetation treatments on the forest ecosystem and help inform future vegetation management decisions in the Sierra Nevada region. Implementation of the Sagehen project alternatives would be consistent with the management goals and direction for the Experimental Forest.

Wetlands and Special Aquatic Features

Areas within the Upper and Lower Sagehen basin have meadows, fens, and wetlands outside of and within proposed treatment units. These features are in various stages of health. Additionally Special Interest Areas (SIAs) of the Sagehen Basin include the Mason Fen and Sagehen Headwaters. The Mason Fen (30 acres) represents the largest fen in the Sagehen Basin vicinity and has a unique botanical assemblage. The Sagehen Headwaters area (79 acres) is located in an intact glacial cirque basin (Section 16, T .18 N., R.15E.). These SIAs are not located within treatment units. Descriptions of project effects and protections for resources associated with these aquatic features are included in the Hydrology, Soils, Plants and Fungi, and Aquatic Biology effects sections of the EA and in the corresponding resource specialist reports.

Wild and Scenic Rivers

Sagehen Creek is recommended as a National Wild and Scenic River System with the Scenic Designation applied to eight miles of Sagehen Creek extending over a 1/4 mile-wide strip on each side of the centerline of Sagehen Creek from its headwaters to where it enters Stampede Reservoir. There are 2,451 acres of National Forest System (NFS) lands and no acres of private lands within the eligible Sagehen Scenic river corridor. Scenic corridors are “Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads”. The designation would also incorporate Management Area 043 (Sagehen Station) which is described in the Tahoe Forest Land and Resource Management Plan (TNF LRMP) (USDA 1990). 5.7 miles of the recommended wild and scenic portion of Sagehen Creek are located within the project area. Until such time when Congress either designates or removes Sagehen Creek from eligibility as a Scenic River corridor, the corridor is to be treated to retain existing Outstanding Remarkable (OR) values. OR values were identified within the Eight Eastside Rivers Wild and Scenic River Study Report and Final Environmental Impact Statement Record of Decision (USDA 1999). These OR values included hydrology, geology, wildlife, fisheries, and plants with biological diversity (associated with fens), and historical values. The OR values of Sagehen Creek would be maintained through project design features, treatment unit methods and locations, and implementation of SMR’s (Appendix A) in RCA’s under the action alternatives. Further details on the protection of resource values within the Sagehen Creek eligible Scenic River corridor, and RCA’s in general, may be found under FONSI Element 10 and the RCO analysis (Appendix D).

Element 4. The degree to which the effects on the quality of the human environment are likely to be highly controversial (40 CFR 1508.27(b)(4)).

The effects of this project on the quality of the human environment are not likely to be highly controversial due to the limited size of the project area, limited scope of Alternatives 1 and 3, and the effectiveness of the project design features and management requirements (detailed in Chapter2 and Appendix A) in reducing impacts on forest resources. The Proposed Action was developed through an extensive collaborative effort with stakeholders so that project design features would address their concerns. Project scoping yielded just nine comments; the comments received were largely supportive (Appendix E). The project is designed to improve wildlife habitat, ecological heterogeneity and forest fuels conditions.

Element 5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks (40 CFR 1508.27 (b)(5)).

The vegetation treatments proposed by both action alternatives are similar to vegetation treatments that have been implemented on the Tahoe National Forest over the past 10 years on numerous projects without having significant impacts. Project design elements and SMRs (Appendix A) included with Alternative 1 and Alternative 3 would reduce and minimize to the point of non-significance any impacts that might have otherwise been uncertain, unique, or unknown.

Element 6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration (40 CFR 1508.27 (b)(6)).

The Action Alternatives would not establish a precedent for any future action, nor represent a decision in principle about a future consideration. The decision would apply only to the Sagehen Project, as described in the descriptions of alternatives (Chapter 2). Any future actions will be analyzed separately and on their own merits through additional environmental analysis and decision making in compliance with NEPA.

Element 7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27 (b)(7)).

A cumulative effect is the consequence on the environment that results from the incremental effect of the action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in sum with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant.

In the following cumulative effects analysis, current resource conditions are used to represent the composite of past actions and natural events that have taken place within the project area. This analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action by action basis. There are several reasons for not taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one cannot reasonably identify each and every action over the last century that has contributed to current conditions. Focusing on the impacts of past human actions risks ignoring the important residual effects of past natural events which may contribute to cumulative effects just as much as past human actions do. By looking at current conditions, we are sure to capture all the residual effects of past human and natural events, regardless of which particular action or event contributed those effects. The Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This approach is consistent with Forest Service National Environmental Policy Act (NEPA) Regulations at Title 36 CFR 220.4(f) (July 24, 2008).

Past, present and reasonably foreseeable future actions

Each resource specialist established geographic and temporal boundaries for their respective cumulative effects resource analysis, and determined past, present and reasonably foreseeable future effects that are relevant within their analysis area boundaries. Since the cumulative effects analysis areas were necessarily different for each resource considered, relevant past, present and reasonably foreseeable future actions varied across the resource analyses. Some of the primary past, present and future actions occurring within the Sagehen Basin are introduced below with more detailed descriptions and inventories in the resource specific sections that follow and in the respective resource specialist reports which are incorporated by reference into this EA.

Vegetation Management: As mentioned in Chapter 1 in the discussion of the history of the Sagehen Basin, the area was heavily logged from the 1870s through the 1930s. The Forest Service purchased most of the land in the Sagehen Basin in 1936. Since 1936, there have been some lower intensity

logging, salvage and fuels operations conducted by the Forest Service; over the past 30-years these have included: Golden Timber Sale (1988, 368acres), Sagehen Salvage Sale (1990, 2,433 acres), Sagehen Fuel Break (1998, 107 acres), and Spring Chicken Fuel Break (2002, 417 acres). Between 1981 and 2005, 1050 acres of timber were harvested on private lands in the basin. Even with these activities and disturbances, there are portions of the basin that have not seen active timber management since the Forest Service acquired land in the Sagehen basin. The Sagehen Project Area itself has only one ongoing vegetation management project, Billymass. This project is under contract, but is not yet complete. This project covers 1,260 acres, 494 of which are within the Sagehen Project Area. All 494 acres are plantations in areas affected by the Donner Ridge Fire (1960). The Tahoe National Forest plans to continue with timber harvest, fuels management and ecological restoration projects in the Sagehen Basin, although no future projects are actively being planned in the basin itself. Projects being actively planned or implemented nearby that were considered for cumulative effects are described in the specific resource sections that follow and in the resource specialist reports incorporated by reference.

Fire: Fires have been actively suppressed, and dense forest conditions have developed in many places of the Sagehen Basin. Portions of the area have been subject to high-severity fire in the past, such as the 1928 Independence Fire, and most notably the Donner Ridge Fire that occurred in the fall of 1960 and burned approximately ⅓ of the Basin (2,500+ acres). The reduction of future severe wildfires is one of its most important goals on National Forests, and influences many of the Sagehen Project design elements.

Livestock Grazing: Active grazing within the Sagehen Basin allotment was discontinued in about 1997; the allotment was for sheep. An Environmental Assessment for the allotment was completed in 2008; the resulting decision permanently removed the allotment from grazing activity.

Road Maintenance and Construction: A network of Forest Service maintained roads is present within the Sagehen Basin totaling approximately 40 miles of roadway. Short sections of three county roads access the northern portion of the area. The Tahoe National Forest is in the process of updating the Forest Transportation System in the Travel Management Process, which may affect the status of roads in the area and may improve resource conditions through improved maintenance activities and restoration of undesignated routes.

Recreation: The Sagehen Basin has not been a high use recreation area historically and recreation facilities are limited in the area. However, ongoing recreational activities may affect some resources within the Sagehen Project area. Recreation activities occurring in the area include: fishing, hunting, off-highway vehicle use and camping.

Forest Vegetation

The following discussion on cumulative effects to forest vegetation for the Sagehen Project is summarized from the project Silviculture report, incorporated by reference as part of this EA previously. The cumulative effects analysis area for forest stands generally encompasses the Sagehen Project Area. This 9,478-acre area includes both National Forest System and private lands, and was selected to capture landscape-level effects of management actions on forest stands. The cumulative effects

analysis temporal scale extends 30 years before and after the present, corresponding with the estimated longevity of vegetation treatments.

Effects of Past Actions on Forest Stands

Past actions that could contribute to a cumulative effect on forest stands in the analysis area include larger vegetation treatments (greater than 10 acres), prescribed fire, and wildland fire exclusion.

Vegetation Treatments. The Sagehen Project Area has had various vegetation treatments over the last 30 years as shown below. (Treatments under ten acres were not included because their scope limits their ability to affect the surrounding landscape.)

- Golden Timber Sale – 1988; 368 acres
  Select Tree Cut and Seed Tree Cut that removed approximately 34 trees per acre between 12 – 35 inches dbh

- Sagehen Salvage Sale – 1990; Sale area boundary encompassed 2,433 acres however salvage harvesting operations were conducted on an estimated 800 acres
  Select Tree Cut that removed approximately 1-5 dead and dying trees per acre

- Sagehen Fuel Break – 1998; 107 acres
  Commercial Thin that removed approximately 200 trees per acre between 3 – 29.9 inches dbh

- Spring Chicken Fuel Break – 2002; 417 acres
  Commercial Thin that removed approximately 200 trees per acre between 3 – 29.9 inches dbh

- Private Land Timber Harvests – 1981-2005; 1,050 acres
  Select Tree Cut, Clearcut, Shelterwood that removed most trees above 14.9 inches dbh

The assorted goals of the above projects drove a variety of treatments within the Sagehen Project Area since the early 1980s. This resulted in some of the variability that exists on the landscape today, but the common factor for all of these treatments is the amount of variability that is lacking within treatment units or at the site scale. Further, these treatments may have the ability to slow certain disturbances, but are most likely not large enough nor strategically placed to significantly interrupt their progression.

Prescribed Fire. Prescribed fire treatments are grouped by two types: pile burning and underburning. Approximately 766 acres of prescribed fire treatments occurred within the cumulative effects analysis area during the past 30 years. An estimated 452 acres were pile burned and 314 acres underburned. Underburning generally consumes surface fuels dispersed throughout a treatment area whereas pile burning consumes aggregated materials. The overall effect of prescribed fire treatments has been to reduce fuel loading within the treated stands, thereby increasing the chances that, in the event of a wildland fire, extensive tree mortality (particularly in trees greater than 12 to 14 inches dbh) would be

minimized. Prescribed fire has had an overall beneficial effect on forest stands within the analysis area, but has not been applied across enough of the Project Area to positively affect the larger landscape.

Fire Exclusion. Forest ecosystems derive beneficial effects from periodic wildland fire, yet this important element of the ecosystem has been excluded in the analysis area for at least the past 100 years in most areas (missing one or more fire return intervals) and 60 years in remaining areas (Donner Ridge Fire). Natural stands in the analysis area and the extensive Donner Ridge and Independence Fires' plantation stands are comprised of tree species and vegetation communities adapted to wildland fire. As a result of fire exclusion, the spatial distribution, composition, and density of vegetation communities have been altered. Shade tolerant species, such as white fir, have benefited, increasing in distribution and composition within stands and at the landscape level, and increasing in density (e.g. greater basal area and number of stems per acre) at the stand level. Conversely, shade intolerant species, such as ponderosa pine and sugar pine, have been detrimentally affected. Effects of fire exclusion over the past 30 years on forest stands cannot be quantified because they depend upon a complex, dynamic interaction of factors that determine fire extent and severity, including fire weather, fuel moisture, aspect, slope, and existing vegetation structure (vertical and horizontal), composition, and density. However, effects of fire exclusion have shaped the existing dense stand conditions prevalent within the analysis area today. Past vegetation treatments may have accomplished some forest health and resiliency benefits; however, these beneficial effects have not entirely compensated for the beneficial effects that would have occurred under more active fire conditions in the analysis area.

Effects of Present Actions on Forest Stands

The Sagehen Project Area has only one ongoing vegetation management project, Billymass. This project is under contract, but is not yet complete. This project covers 1,260 acres, 494 of which are within the Sagehen Project Area. All 494 acres are plantations from the Donner Ridge Fire and have spacing guideline prescriptions similar to those prescribed for units 46 and 47 in this project. The effect of this present action would not only free up available resources for the remaining trees within the Billymass Project units, but are large enough to affect how a disturbance, particularly fire, might move through the Project Area. Unlike Sagehen Project plantation prescriptions, however, there is little variability prescribed for these units at the site, stand, or landscape scale.

Effects of Reasonably Foreseeable Future Actions on Forest Stands

There are no known reasonably foreseeable future vegetation management projects within the analysis area. Although wildland fire exclusion is expected to continue with effects as described above for past actions, the desire for some level of prescribed and wildfire at intervals consistent with natural fire regimes to be returned to the Sagehen Basin is recognized. However, because the uncertainty of budgets and time for future analysis and implementation, evaluating effects of additional prescribed fire that has not been planned for is outside the scope of this analysis.

Summary of Effects of Past, Present, and Future Actions on Forest Stands

Overall, assorted goals drove a variety of treatments within the Sagehen Project Area since the early 1980s. This drives some of the variability that exists on the landscape today, but the common factor for all of these treatments is the amount of variability that is lacking within treatment units and at the site

scale. These past treatments may have the ability to slow certain disturbances; however, all but the Billymass units are most likely not large enough or strategically placed to significantly interrupt their progression. The Billymass units are large enough to interrupt larger disturbances, but could only do so from the southeastern portion of the Project Area.

Cumulative Effects under Alternative 1

Under the Proposed Action Alternative (Alternative 1), forest stands would improve in structure and resilience with a positive net effect over the entire Sagehen Project Area. This is generally due to the decrease in competition among all remaining trees in both past and proposed action units as well as the presence of some larger scale variability in past action units and the multi-scaled variability resulting from proposed action treatments. Further, where treatment units overlap with some of the homogenous treatments of the past, prescriptions aim to not only take advantage of the positive attributes of past treatments (such as reducing competition around larger trees), but are designed also find opportunities to introduce more heterogeneity within them. Past treatment areas that do not overlap with Alternative 1 treatments would most likely continue to develop aided by the increased resiliency from surrounding treatments, but with minimal smaller scale and strategically introduced variability. Ultimately, the cumulative effects of the past and present treatments combined with Alternative 1 treatments would benefit individual tree growth and resiliency within all units (historical, present or proposed), and by having reduced competition within all units, larger scale disturbances that could occur within the Sagehen Project Area would most likely be interrupted. Therefore, Alternative 1 would result in a positive cumulative effect on forest stands in the analysis area over the 30-year cumulative effects analysis temporal scale.

Cumulative Effects under Alternative 2

Under the “No Action” Alternative (Alternative 2), current declining forest health trends would continue in the Sagehen Project Area, particularly outside of past treatment unit boundaries. Stand densities would continue to increase and forest fuels would continue to accumulate. In the absence of disturbance, such as wildfire, shade intolerant tree numbers would decline due to lack of sunlight. Structural diversity would slowly improve as large trees died and created gaps for regeneration. Because of the limited amount of light reaching the forest floor, most regeneration would be shade tolerant species, such as white fir. White fir is less able to tolerate drought or fire than the less shade tolerant pines. Implementation of Alternative 2 would result in adverse indirect impacts on forest health, specifically stand density and tree species composition. Past treatment areas would most likely continue to develop, but would be at a higher mortality risk from disturbances from surrounding untreated stands. Therefore, Alternative 2 would result in a negative cumulative effect on forest stands in the analysis area over the 30-year cumulative effects analysis temporal scale.

Cumulative Effects under Alternative 3

Under the “Non Commercial Funding” Alternative (Alternative 3), current declining forest health trends would continue in the Sagehen Project Area, particularly outside of past treatment unit boundaries and outside Alternative 3 unit boundaries. Conditions within past unit boundaries and Alternative 3 unit boundaries (to a slight extent since this alternative is focused on hazardous fuels reduction and is not designed to address forest health needs) would be on a more resilient trajectory, but are not large

enough to complement each other or provide sufficient benefit to the larger landscape. Therefore, Alternative 3 would result in a negative cumulative effect, albeit slightly less than Alternative 2, on forest stands in the analysis area over the 30-year cumulative effect analysis temporal scale.

Fire and Fuels

A 23,000-acre area which includes both National Forest System and private lands, was selected to capture landscape-level cumulative effects of management actions and fire history on forest stands. This cumulative effects analysis area was selected because Farsite modeling indicated that a fire could potentially move far outside the Project Area depending wind direction and location of fire starts.

Effects of Past Actions or Events on Fire Behavior

Past actions that could contribute to a cumulative effect on forest stands in the analysis area include vegetation treatments larger than 10 acres, prescribed fire, larger wildland fires, and wildland fire exclusion.

Stand conditions in the Sagehen Basin have been significantly altered by human activities since the early 1870s. From the 1870s through 1930s several sawmills were located throughout the Basin removing most of the merchantable timber. As a result, the area is largely comprised of homogenous, even aged stands composed of trees up to 120 years old. These conditions have increased the potential for large scale, stand replacing fire.

In 1926, the Independence Fire burned 2,653 acres along the northwest portion of the Sagehen Basin, and in 1960 the Donner Ridge Fire burned 44,812 acres of which approximately 1600 acres were along the southeast portion of Sagehen Basin. Reforestation efforts after the fires resulted in 1,347 acres of Jeffrey pine plantations in the Basin. The resulting even aged, pure Jeffrey pine plantation stands are not naturally occurring in the area and have a higher potential for crown fire because of increased ladder fuels in the form of small trees and brush.

Since the early 1900s, fire suppression policy has excluded most wildfire from the cumulative effects analysis area; however, stand replacing fires (Independence and Donner Ridge Fires) have affected some areas of the Sagehen Basin. Effects of fire exclusion over the past 100 years for most of the analysis area's forest stands cannot be quantified because they depend upon a complex, dynamic interaction of factors that determine fire extent and severity, including fire weather, fuel moisture, aspect, slope, and existing vegetation structure (vertical and horizontal), composition, and density. However, the effects of fire exclusion have shaped the existing dense stand conditions prevalent within the analysis area today. Forest ecosystems derive beneficial effects from periodic wildland fire, yet this important element of the ecosystem has been largely excluded in the analysis area over the past 100 years.

The Sagehen Project Area has had various vegetation and fuels treatments over the last 30 years as shown below (treatments under 10 acres excluded because of limited effects on the landscape):

- Golden Timber Sale – 1988; 368 acres

Select Tree Cut and Seed Tree Cut, which removed about 34 trees per acre between 12 – 35 inches dbh

- Sagehen Salvage Sale – 1990; 2,433 acres (800 of which were directly affected)
  Select Tree Cut, which removed about 1-5 Dead and Dying trees per acre
- Sagehen Fuel Break – 1998; 107 acres
  Commercial Thin, which removed about 200 trees per acre between 3 – 29.9 inches dbh
- Spring Chicken Fuel Break – 2002; 417 acres
  Commercial Thin, which removed about 200 trees per acre between 3 – 29.9 inches dbh

- Private Work – 1981-2005; 1,050 acres
  Select Tree Cut, Clearcut, and Shelterwood Cut, which removed most trees above 14.9 inches dbh

The most intensive treatments within the Sagehen Basin have occurred on private land. Although these treatments were not designed to reduce fuels, they have reduced fuel loading within and around the northwestern portions of the Sagehen Basin. Past vegetation treatments may have accomplished some of the forest health and resiliency benefits absent due to fire exclusion; however, these beneficial effects have not entirely compensated for the beneficial effects that would have occurred with active fire conditions under a more active fire regime in the analysis area.
Approximately 766 acres of prescribed fire treatments have been conducted within the cumulative effects analysis area during the past 30 years. An estimated 452 acres were pile burned and 314 acres underburned. The overall effect of prescribed fire treatments has been to reduce fuel loading within the treated stands, thereby increasing the chances that, in the event of a wildland fire, extensive tree mortality (particularly in trees greater than 12 to 14 inches dbh) would be minimized. Underburning has proven most beneficial to forest stands; however, since only 314 acres received that treatment over the past 30 years, beneficial effects of underburning across the larger landscape have not been realized.

Effects of Present Actions on Fire Behavior

The Sagehen Project Area has only one ongoing vegetation/fuels management project: the Billymass Project. This project is not yet complete. 944 acres of the 1260 acre project lie within the cumulative effects analysis area and consist of plantation forest stands from the Donner Ridge Fire. The anticipated effect of the present action will be to enhance the growth of the remaining trees within the Billymass Project units and allow them to attain more fire resilient features. The treatment units are large enough to moderate fire behavior if a wildfire moved north and east from the south and west portions of the analysis area.

Effects of Reasonably Foreseeable Future Actions on Fire Behavior

There are no known reasonably foreseeable future fuels management projects within the analysis area. While future prescribed fire treatments consistent with natural fire regimes are desirable, additional prescribed fire projects have not yet been planned and are uncertain given budget constraints.

Summary of Effects of Past, Present, and Future Actions on Landscape Fire Behavior

Overall, assorted goals drove a variety of treatments within the cumulative effects analysis area since the early 1980s. These past treatments would provide places for firefighters to engage in wildfire suppression activities; however they are not large enough to substantially interrupt a wildfire's advancement. The only treatments that could possibly interrupt the progression of a wildfire are the Billymass units, but they would be primarily effective if a fire started in or below the southeastern portion of the Project Area. Past, present, and future actions within the analysis area would have minimal cumulative effects in terms of modifying landscape-level fire behavior under all alternatives.

Cumulative Effects under Alternative 1

The Sagehen Project would provide the largest and most extensive fuels treatments within the Sagehen Basin. Cumulative effects on large-scale fire behavior would be attributed to the indirect effects of Alternative 1. Under this alternative, landscape scale wildland fire behavior would be modified through the reduction of hazardous fuel loading within the Sagehen Project Area. The cumulative effects of this project could encompass up to 23,000 acres. Ongoing fire exclusion would continue to allow fuels to accumulate; however, this effect would be partially offset by the actions to reduce fuels proposed under Alternative 1. The placement and size of vegetation treatment units have been strategically oriented to interrupt the forward spread of high severity wildfire and to enhance the effectiveness of wildland fire suppression actions. Alternative 1 would reduce flame lengths, rate of spread, and fire type (compared to existing conditions) in proposed treatment areas. It would also augment reforestation efforts of the past by creating more fire resilient forest stand structures. Ultimately, the cumulative effects of the placement and size of treatment areas under Alternative 1 would benefit the larger landscape by moderating landscape scale fire behavior.

Cumulative Effects under Alternative 2

Under the "No Action" Alternative (Alternative 2), the Sagehen Project Area would continue to be at risk for severe landscape scale wildland fire behavior. The current declining forest health trends would continue in the Sagehen Project Area, particularly outside of past treatment area boundaries. Fuel loading would continue to increase, leading to an increase in fire behavior variables, including rate of spread, flame length, and fire type. Past treatments could provide places for firefighters to engage in wildfire suppression activities; however they are not large enough to substantially interrupt a wildfire's advancement. The only treatments that could possibly interrupt the progression of a wildfire are the Billymass units, but they would be primarily effective if a fire started in or below the southeastern portion of the Project Area. Therefore, Alternative 2 would result in a negative cumulative effect on fire behavior over the 23,000-acre cumulative effects analysis area. The forest habitat and people visiting or living in the area would remain at risk from severe stand replacing fires created by the excessive fuel loading and the dense tree and brush growth that exists.

Cumulative Effects under Alternative 3

Under the "Non Commercial Funding" Alternative (Alternative 3), only a subset of the proposed action's treatment areas would benefit from reduction of hazardous fuel loading. Therefore, landscape scale wildland fire behavior would only be slightly altered. Conditions within past treatment areas and Alternative 3 treatment unit boundaries would not result in a sufficiently extensive portion of the Basin treated to substantially alter the potential for large stand replacing fires. Treated areas under Alternative 3 are not large, nor strategically oriented enough to complement each other or provide sufficient benefit in terms of modifying fire behavior across the larger landscape or greatly enhancing fire suppression actions. As noted above, the only treatments that could possibly interrupt the progression of a wildfire are the Billymass units, but they would be primarily effective if a fire started in or below the southeastern portion of the Project Area. Ongoing fire exclusion would continue to allow fuels to accumulate; however, this effect would be somewhat offset by the actions to reduce fuels proposed under Alternative 3, but to a lesser extent than Alternative 1. Alternative 3 would not materially alter landscape-scale fire behavior within the 23,000-acre cumulative effects analysis area; however, it would still have a positive effect on modifying fire behavior in the treated areas.

Soil Productivity

For the soil resource, cumulative effects analysis is the assessment of the direct and indirect effects of the proposed action alternatives in context with the existing conditions. The cumulative effects assessment area for the soil resource is bounded in space within the proposed activity areas, where a potential for soil disturbing activities take place. The analysis is further bounded in time by the foreseeable future period during which effects of this project could persist as detectable effects and may be short- term or long-term in nature. Past effects are accounted for based on the existing conditions or present time, and reasonably foreseeable future actions are those proposed actions assessed within this document. There are no other future foreseeable actions in addition to the Sagehen Project within the resource activity area (unit) boundaries. Since no change in existing conditions is proposed under Alternative 2, no variation in existing trends for cumulative effects to soils resources would occur. The following analysis discusses cumulative effects under Alternatives 1 and 3. For activity areas treated and not related to temporary roads or restoration under Alternative 1, and for all activity areas under Alternative 3, Forest Plan Standard and Guideline #55 (1990 LRMP, pg. V-36) is expected to be met for porosity, effective soil cover, and organic matter over proposed the activity areas. Thus, based on the direction for soils laid out in the Forest Plan, cumulative effects to productivity are not expected to decrease productivity below existing conditions.

Areas with decreased porosity as a result of actions under Alternatives 1 and 3 could remain on the landscape over the long-term and with each entry can incrementally increase the degree and extent of the detrimentally affected area. However, the proposed action is not predicted to exceed the Standard and Guideline (S&G) #55 when BMPs/SMRs are implemented because: (1) existing levels of compaction are considered to be moderate to low (well under the 15 percent threshold in extent), and (2) the potential for incremental changes in degree (up to 10% decrease in porosity) do not necessarily equate to an increase in extent of area that exceeds the threshold (in degree or extent). For the Sagehen Project, S&G #55 is expected to be attained and productivity would be maintained.

Existing conditions within activity areas have Effective Soil Cover (ESC) that meet the S&G #55 requirements, so no areas of special concern were identified based on existing conditions.
There is the potential to reduce existing cover in degree and extent over small portions the activity areas, but ESC would be maintained. Additionally, there would also be periods of increased ESC during some intermediate steps on some units. In particular, for thinned areas designated for grapple piling there would be areas with concentrations of increased duff and down wood following thinning, before grapple piling is initiated. There would also be potential increases in existing ground cover in mastication units. Undisturbed forest duff and sites would ensure maintenance of a minimum of 20 percent of the undisturbed forest duff evenly distributed throughout the activity area; therefore, S&G #55 would be attained and productivity would be maintained for duff.

Underburning can reduce levels of existing large down wood in upper decay classes in treatment units. Following underburning the cycling of large downed wood could be enhanced in some thinned and un-thinned units in areas where conifers are negatively fire affected. This effect is predicted to be limited and there could be lag time before snags fall and contribute to the large woody material. Since it has been demonstrated that S&G #55 would be attained for large woody material, productivity would be maintained for large wood under the proposed action.

Loss of Productivity
Under Alternative 1, temporary roads disrupt productivity of the soils. Loss of productivity would occur through detrimental compaction (decreased porosity), loss of effective soil cover, and loss of organic matter from temporary roads on 3.8 miles, over approximately 5.5 acres until these temporary roads were decommissioned. These lands would be re-entered into productivity within about 8 years (5 years operation period and 3 years to begin vegetative recovery) but may not achieve pre-existing productivity levels for several more years. No temporary roads are proposed under Alternative 3.

Restored Productivity
Under Alternative 1, there would be approximately 1 mile of road template with approximately 4.5 acres restored. An existing road bed would be decommissioned, re-vegetated, and mulched. The restoration will allow these lands to be available for re-entry into productivity. The lands would be entered into productivity within about 8 years (5 years operation period and 3 years to begin vegetative recovery) but, may not achieve the potential productivity levels for several more years. It is estimated that in combination with the aspen restoration treatment (conducted as conifer removal), the fen, and wetland soil and organic matter in the area surrounding the fen, could be improved over approximately three acres over the long term. No restoration activities are proposed under Alternative 3.

Hydrology

Methodology

The Sagehen Project Cumulative Effects Analysis (CWEA) compared the level of land disturbance within a watershed with an estimate of the upper limit of watershed tolerance to disturbance, referred to as the Threshold of Concern (TOC). The level of land disturbance is measured using Equivalent Roaded Areas (ERAs), in which all disturbances are compared to an equivalent acre of road. The ERA/TOC comparison provides a simplified accounting system for tracking disturbances that affect watershed processes. It also provides an indication of watershed condition and is an indicator of potential risk for a Cumulative Watershed Effect. Extensive details about the ERA/TOC analysis method are available in the Sagehen Project Hydrology Report, which is incorporated by reference and available upon request.

As the ERA disturbance estimate approaches or exceeds the TOC, the ERA/TOC ratio approaches or exceeds one. An ERA that approaches or exceeds the TOC prompts closer examination of on-the-ground factors to determine where, if necessary, application of extra care or additional measures would reduce the risk and maintain or improve watershed conditions. The ERA/TOC ratios are less than one for both Alt. 1 and Alt. 3 (less than or equal to 0.9).

Analysis Boundaries

Past, present and future watershed disturbances included in the CWEA analysis were recorded in a geographic information systems layer and include Forest Service projects, roads, timber land conversions (such as private land development) and timber harvests on private lands. The cumulative effects temporal analysis boundaries are tied to the disturbance recovery curves. These consider constant features that stay on the landscape, and those that recover through time. For example, vegetation manipulation with mechanical equipment has a recovery curve of approximately 30 years, and therefore disturbances that occurred 30 years in the past or would occur into the future are included in the analysis. The recovery curve is 7 years for wildfire and 5 years for most non- mechanized fuels treatments (based on the assumed recovery period for land disturbing activities.

The analysis area for assessing cumulative effects is the Hydrologic Unit Code level 7 (HUC 7) scale within the three drainages containing the proposed actions: Upper Sagehen, Lower Sagehen, and Saddle Meadow. Since minor activities are proposed within the Prosser Creek Drainage area, a simplified cumulative watershed effects analysis was conducted for this drainage and results are also discussed below. A map showing the boundaries of these drainages (as well as encompassing HUC 6 catchments) is included as an attachment to the Sagehen Project Hydrology Report.

The disturbance layer and data used to calculate ERAs for the alternatives are part of the project record and are available upon request.

Cumulative Risk Assessment

The potential for cumulative effects risk discussed below is based on the ERA analysis methodology and professional experience. Table 3.24 summarizes the risk assessment modeling results. The risk ratings given to catchments are as follows:

- **Risk rating of unlikely:** ERA is below 0.9 and there are no other identified circumstances that contribute to risk or reduce risk.

- **Risk rating of not likely to low:** ERA is above 0.9 and there are some other identified circumstances that might contribute to a cumulative effect.
- No other ratings were determined for this analysis area.

Table 3.24. Sagehen Project ERA/TOC analysis by alternative.

ERA Condition Assessment			MAX Alt 1		Existing Alt 2		MAX Alt 3	
HUC 7 Watershed	**Acres**	**TOC**	**% ERA**	**ERA/ TOC**	**% ERA**	**ERA/ TOC**	**% ERA**	**ERA/ TOC**
Little Truckee River – Sagehen Catchment (HUC 6)								
Upper Sagehen	6857	13	8.5	0.65	4.1	0.31	7.01	0.54
Lower Sagehen	3517	13	11.5	0.88	3.2	0.25	10.47	0.81
Little Truckee River – Independence Lake Catchment (HUC 6)								
Saddle Meadow	5216	12	10.0	0.91	8.0	0.72	9.1	0.83

Upper Sagehen and Lower Sagehen Drainage Areas

Under Alternative 1, the Upper Sagehen Drainage area has an ERA/TOC ratio at 0.65 while the Lower Sagehen Drainage area is also below threshold having an ERA/TOC ratio of 0.88. ERA results for both the Upper Sagehen and Lower Sagehen Drainages indicate an unlikely risk for a cumulative effect since the disturbed area remains sufficiently below threshold for these drainage areas. Additionally, the assessed Sagehen drainage proper is in good stream health as indicated by aquatics survey information. It is unlikely that a cumulative effect from Alternative 1 would occur in either the Upper or Lower Sagehen Drainage Areas based on the assumptions of the ERA analysis. Because Alternative 3 would treat fewer acres in these drainage areas, the risk of cumulate watershed effects under Alternative 3 is lower compared to Alternative 1.

Under the no action alternative (Alternative 2), existing conditions for the Upper and Lower Sagehen Drainages are well below the TOC with the ERA/TOC ratio of 0.31 in the Upper Sagehen watershed and 0.25 in the Lower Sagehen Watershed. It is unlikely that a cumulative effect from existing conditions as assessed through the current disturbance history would occur under Alternative 2 in either the Upper or Lower Sagehen basin based on the assumptions of the ERA analysis.

Saddle Meadow Drainage

The Little Truckee River Independence Lake Catchment (HUC 6), includes the Saddle Meadow Drainage (HUC 7) and the Independence Creek Drainage (HUC 7). The Sagehen Project action alternatives are within the Saddle Meadow HUC 7 drainage. This HUC 7 drainage is below threshold under Alternative 1 having an ERA/TOC ratio of 0.91. However, because this ratio is approaching the TOC, the CWE analysis considered calculated risk from the upstream Independence Lake HUC 7 drainage, which is outside of

the disturbed area analysis area, because both of these HUC 7 watersheds discharge into the Little Truckee River – Independence Lake HUC 6 Catchment. Independence Creek Drainage (HUC 7) was determined to have an estimated ERA/TOC ratio of 1.18 under the analysis for the recent (decision signed in 2012) Transition Project on the Sierraville Ranger District. The cumulative effects risk in the Independence Creek HUC 7 drainage was rated moderate under the CWE analysis conducted for the Transition Project.

When considering that the Saddle Meadow ERA is approaching the ERA/TOC threshold, the risk for a cumulative effect is slightly increased due to the potential risk associated with the Independence Creek watershed upstream of the project area. However, there are several moderating effects. The risk for a cumulative effect would not be greater than "not likely to low" for two primary reasons. First, the contributing area above Saddle Meadow Drainage also includes the Independence Lake Drainage area and contributing flows from the Little Truckee River through and including Cold Stream Drainage area. Independence Lake is reservoir-controlled, and the portion of the Little Truckee River that runs through the Cold Stream Drainage area was recently improved through restorative techniques. Both the reservoir and the restoration provide hydrologic controls decreasing the potential maximum peak flows that can occur under flooding events. The hydrologic response from these features can decrease the impact of cumulative effects on in-stream channel erosion and decrease potential cumulative effects occurring during flood producing precipitation events. Second, the magnitude of any increase in peak flow in response to forest management diminishes with increasing basin area. If projects in the Independence Creek Drainage (HUC 7) were to contribute to a cumulative effect, there would be a low potential contributing effect from activities proposed under Alternative 1 in the Saddle Meadow Drainage. Because Alternative 3 would treat fewer acres in this drainage area, the risk for adverse cumulative watershed effects is lower under Alternative 3 compared to Alternative 1.

Prosser Creek Drainage

The affected area from Alternative 1 in the Prosser Creek Drainage is small (44.2 acres of mastication with prescribed underburning and 3.7 acres underburn only). The maximum change in the ERA/TOC ratio is less than a 0.03 maximum change over the analysis period. Recent actions in this drainage basin have consisted of low impact activities, such as prescribed surface fire and mastication; hence, recent activities within the watershed would not cause this watershed to exceed the threshold of concern for potential cumulative watershed effects. Alternative 3 would not affect this drainage.

Wildlife

This section of the EA assesses the cumulative effects to terrestrial wildlife species considered in the direct and indirect effects analysis under FONSI Element 1. It is based on the project BE/BA previously incorporated by reference and available upon request from the Tahoe National Forest.

Cumulative Effects Common to All Species

The 29,467 acre wildlife analysis area (22,237 National Forest system lands, 7,230 Private land) is delineated to analyze cumulative effects to threatened, endangered, proposed, candidate and Forest Service sensitive species and their habitats, including past, present, and reasonably foreseeable future actions, including the direct and indirect effects of the Sagehen Project action alternatives (e.g. disturbance related to thinning). The cumulative effects boundary extends 1.5 miles beyond the project area. This area is large enough to encompass the known home ranges of species being analyzed within the basin, yet not so large as to mask any potential effects.

Cumulative effects are defined temporally to extend approximately 30 years before and 20 years after the present; in correlation with the estimated impacts of vegetation treatments on Forest Service and private lands that are still influencing current conditions. The Donner Ridge Fire of 1960 had a profound and significant effect on vegetation conditions within the Basin, but the vegetation changes resulting from this stand replacing event have been incorporated into the existing condition. This provides a reasonable timeframe to describe changes to wildlife habitat and landscape patterns that may influence the distribution and abundance of species within the Basin and surrounding areas, including species such as the Pacific marten, Northern goshawk, and California spotted owl.

Cumulative effects from past, present, and reasonably foreseeable future projects have greatly shaped the ecosystem and wildlife habitats in the Sagehen analysis area. Although the effects of 1960 Donner Ridge Fire are reflected in the current vegetation condition, this large stand-replacing wildfire tremendously transformed the Sagehen Basin landscape in the long-term and undoubtedly had a significant impact on distributions and abundance for species such as the marten, spotted owl, and goshawk. Table 3.25 below provides a summary of past, present, and reasonably foreseeable future actions within the spatial and temporal bounds established for the cumulative effects analysis that have affected wildlife species and their habitats.

Table 3.25. Effects of Past, Present, and Reasonably Foreseeable Future Projects (Analysis Area - 29,467 acres)

Year	Project	Activity	Cumulative Effect	Acres
Past Actions				
1981-1987	Various Projects	Broadcast burning	More open understory resulting in reduced habitat quality and quantity for small mammal and bird species in the short term. No affects to overstory of CWHR.	60
1981-1987	Various Projects	Commercial Thin	Reduction in canopy cover resulting in reduced habitat quantity for late-successional wildlife species including marten, goshawk, and spotted owl	126

Year	Project	Activity	Cumulative Effect	Acres
1981-1987	Various Projects	Overstory Removal Cut (from advanced regeneration)	Long-term removal/loss of late-successional habitat for marten, goshawk, spotted owl, increased early seral habitat for deer and mountain quail	15
1981-1987	Various Projects	Precommercial Thin	Removal of trees <6-10 inch dbh creating more open understory tree layer	205
1981-1987	Various Projects	Stand Clearcut	Long-term removal/loss of late-successional habitat for marten, goshawk, spotted owl, increased early seral habitat for deer and mountain quail	166
1981-1987	Various Projects	Tree Release and Weed	More open understory and potentially affecting small mammal and bird species in the short term. No affects to overstory of CWHR.	28
1988-1994	Sierraville RD – Various Sanitation/Salvage Projects	Sanitation/Salvage- Select tree cut that removed dead and dying trees	Removal/loss of large wood (snags and logs) resulting in long-term degradation of habitat quality and important habitat components needed for denning, resting, foraging for marten, goshawk, spotted owl	1,254
1988	Golden Timber Sale	Select Tree Cut and Seed Tree Cut that removed approximately 34 trees per acre between 12 – 35 inches dbh	Long-term removal/loss of late-successional habitat for marten, goshawk, spotted owl, increased early seral habitat for deer and mountain quail	368
1990	Sagehen Salvage Sale	Select Tree Cut that removed approximately 1-5 dead and dying trees per acre	Removal/loss of large wood (snags and logs) resulting in long-term reduction in habitat quality and important habitat components needed for denning, resting, foraging for marten, goshawk, spotted owl	800
1998-2002	Sagehen and Spring Chicken Fuel Breaks	Commercial Thin that removed approximately 200 trees per acre between 3 – 29.9 inches dbh, with the majority in the smaller diameter size classes (i.e.<12 inch dbh)	Dense canopy cover reduced to lower canopy cover, loss of understory vegetation from prescribed burning, and removal of snags/logs resulting in short-term reduction in habitat quality for marten, goshawk, spotted owl along roads. Increase in edge habitat enhanced foraging for goshawk. Limited	576

Year	Project	Activity	Cumulative Effect	Acres
			landscape effects.	
1981-2012	Private Land Timber Harvests	Select Tree Cut, Clearcut, Shelterwood, and thin from below that removed most trees above 15 inches dbh	Removal/loss of late-successional habitat for marten, goshawk, spotted owl, increased early seral habitat for deer and mountain quail	3,500
1994-1998	Private Land Timber Harvests that have been acquired by Forest Service	Select Tree Cut, Sanitation, Salvage, that removed most trees above 15 inches dbh	Removal/loss of late-successional habitat for marten, goshawk, spotted owl, increased early seral habitat for deer and mountain quail. Reduction in snags and logs.	953
1988-1994	Various Projects	Mastication of shrubs and sometimes small diameter trees <3 inch dbh	More open understory that reduced amount of habitat available for small mammal and bird species used for resting, foraging, and/or nesting in the short term. However, goshawk may have benefitted by enhanced travel cooridors within the tree understory. No changes to overstory of CWHR type.	53
1988-1999	Hobart YG and Other Projects	Stand Clearcut	Removal/loss of late-successional habitat for marten, goshawk, spotted owl, increased early seral habitat for deer and mountain quail	110
1988-1999	Various Projects	Pre-commercial Thin	Removal of trees <6-10 inch dbh creating more open understory tree layer that reduced habitat quality for prey species, but may have provided increased access to predators, including Northern goshawk.	1,085
1995 - 1999	Alder Prosser Compartment Plan	Commercial Thin/Mastication	Short-term reduction in canopy cover, likely resulting in more open stands and some reduction in habitat quality for late-seral species	4
2000 - 2011	Billy Fuel Reduction Project (Billy Goat)	Mastication	Removal of shrubs and sometimes small diameter trees <3 inch dbh resulting in reduction of decadent and over-dense deer brush and small trees. Benefits to early and mid-seral species	180

Year	Project	Activity	Cumulative Effect	Acres
			by rejuvenating browse within Donner Fire Plantations	
2000-2011	Liberty Forest Health Improvement, Stampede, and Zingara Projects	Commercial Thin/Underburn - thin from below for forest health improvement	Reduction in canopy cover that resulted in more open stands and short-term reduction in habitat quality for late-seral species	504
2000-2011	Zingara Project	Sanitation/Salvage	Removal/loss of snags and/or diseased trees resulting in long-term degradation of habitat quality and important habitat components needed for denning, resting, foraging for marten, goshawk, spotted owl	16
2010	Sagehen Test Plot	Commercial Thin/Underburn	Some short-term reduction in habitat quality for mature and late-seral species, Increase forest structure and heterogeneity, ecosystem resiliency, and fuels hazard reduction.	5
2000-2011	Liberty, Scraps, and Sagehen Test Plot	Group Select - Removal of all trees <30 in dbh between up to 1 acre	Increase in habitat for early seral species, increase in forest seral stage diversity across units, likely not to alter overall suitability of habitat for mature to late-seral forests species	43
2000-2011	Various projects including Billy Fuels Reduction, Alder Prosser Compartment Plan, Hobart YG, and Liberty Forest Health Improvement	Pre-commercial Thin	Removal of trees <10 inch dbh creating more open, homegeneous understory tree layer which reduces cover and habitat quality for wildlife, including prey species for Sensitive species	1,182
Present and Reasonably Foreseeable Future Projects				
2009-2015	Phoenix Project - Koruna and Lira Contracts	DFPZ, group selection, small group selection, variable thinning, follow up fuels treatment, underburning, hand thin and masticate.	Some short-term reduction in habitat quality for marten, goshawk, and spotted owl. Fuels hazard reduction.	562
2000 -2013	Billy Grunt	Mastication of shrubs and sometimes small diameter trees <3 inch dbh	Reduction of decadent and over-dense deer brush and small trees. Some benefits to early and mid-seral species by rejuvenating browse within Donner Fire Plantations	180
2002-2013	Billy Mass	Plantation thinning of trees <14” dbh limit with whole tree yarding and mastication with removal of trees for public fuelwood, spreading of chips	Improvement in canopy structure for early and mid-seral species with short-term impacts to prey species, such as	1,648

Year	Project	Activity	Cumulative Effect	Acres
		and burning of slash piles	small mammals and songbirds.	
2012-2013	Outback	Aspen restoration-remove competing conifers within aspen	Increased foraging habitat quality for goshawk/marten/spotted owl, but loss of late-seral habitat.	6
2013	Sagehen Project	Variable thinning, legacy tree treatment, suppressed cut, decadent feature enhancement, dense cover areas, early seral openings, and fuels treatments including underburning, mastication, and pile burning	Short-term reduction in habitat quality in a portion of marten, goshawk, and spotted owl suitable habitat. Long-term benefits from increased forest heterogeneity, ecosystem resiliency, and fuels hazard reduction.	2,654
2013	Transition	DFPZ, group selection and variable thinning, follow up fuels treatment and underburning. Plantation treatment, masticate & grapple pile.	Short-term reduction in foraging habitat for late-seral species, such as goshawk, spotted owl, and Pacific marten. Reduced risk of stand-replacing fire event.	1,038
2012-2017	Independence Lake Forest Thinning and Fuels Reduction THP - The Nature Conservancy (Upper Sagehen Creek, Independence Lake, Lower Independence Creek)	Forest Thinning and Fuels Reduction using variable thinning, mastication, and prescribed underburning (160 acres is biomass thinning)	Short-term reduction in foraging habitat for late-seral species, such as goshawk, spotted owl, and Pacific marten, Long-term benefits from increase forest resiliency, heterogeneity, and diversity.	611
2009-2017	Independence Lake Fuel Break	1 mile length along fuelbreak	Reduction in snags and reduced canopy cover resulting in reduced habitat quality for late-seral species, such as goshawk, spotted owl, and Pacific marten	23
2014	Dry Creek	Plantation thinning, large tree treatment, dense cover areas, early seral openings, and mastication	Some short-term reduction in habitat quality for goshawk. No suitable marten or spotted owl habitat in project area.	194

Past Projects

Past timber harvest projects, particularly those from the early 1980's to the 1990's had the greatest impact on wildlife habitats within the Basin and surrounding areas. The Golden Timber Sale of 1988 harvested approximately 368 acres of forested habitat where the majority of large trees were removed resulting in the loss of old forest habitat which is still evident on the landscape today. In addition, the Sagehen Salvage Sale of 1990 and various other sanitation and salvage projects (1988-1994) removed dead and dying trees over a broad area (>2,000 acres), affecting snag and down log associated species,

including cavity-nesting birds and mammals, goshawk, marten, and spotted owl. Private land timber harvests, including 953 acres that have been subsequently acquired by the Forest Service, within the analysis area have been extensive and have included select tree harvest, clearcuts, and shelterwood cuts. Approximately 4,500 acres of timber harvests on private lands within the analysis area have removed the majority of trees above 15 inches dbh resulted in loss of old forest habitat and can be attributed to the current mid-seral forest condition that characterizes much of the existing conditions in the Basin and surrounding areas today. Recent marten research conducted within the Sagehen Experimental Forest (Moriarity et al. 2011) summarized the impacts of past timber harvest and their effects on the marten. The study suggests that the marten population within the Basin declined during this period of intensive timber harvest. Past timber harvests included in the Moriarty et al. (2011) study are also identified as past actions analyzed for cumulative effects for the Sagehen Project.

Various mastication and pre-commercial thinning projects conducted from the late 1980's to 1999 have resulted in more open and less complex understory conditions on over 1,000 acres, which has likely affected the abundance and distribution small mammals and songbird species, including prey for spotted owl, goshawk, and marten. The Sagehen and Spring Chicken fuel break projects of the late 1990's were commercial thinning treatments alongside roads to provide strategic firefighting safety zones. They removed approximately 200 trees per acre between 3 – 29.9 inches dbh, with the majority in the smaller diameter size classes (i.e. <12 inch dbh) and resulted in reduced canopy cover in both the overstory and understory vegetation. Though these types of treatments produced more open and less complex forest structure, these linear treatments were limited in their scope in terms of modifying overall forest characteristics at the stand or landscape scale. Rather they served to increase horizontal diversity and may likely have created more open situations favorable to certain prey species as well as facilitating foraging corridors for goshawk.

More recent forest management (2000-present) activities in the wildlife analysis area under the strategy of the Herger-Feinstein Quincy Library Group Forest Recovery Act Pilot Project (1999) and the Sierra Nevada Forest Plan Amendment (2004) focused on forest health and fuels reduction treatments aimed at protecting and maintaining large trees, higher canopy cover, and snags and down logs for wildlife while reducing stand-replacing catastrophic wildfires. The Scraps, Liberty, Stampede, and Zingara projects include over 500 acres of commercial thinning, group selection, and fuels treatments (mastication and underburning). Together these projects resulted in various degrees of short-term habitat change at the patch-scale, but overall project design standards were to maintain suitable habitat for the goshawk, marten, and spotted owl at the stand or landscape scale. Also, within this time period, pre-commercial thinning on over 1,000 acres removed small diameter trees, typically <10 inch dbh, aimed at reducing ladder fuels and inter-tree competition. These treatments resulted in more open and homogeneous understory conditions that likely have had localized impacts to prey species including small mammals and songbirds by reducing and eliminating cover needed for resting, foraging, and nesting. Approximately 2,000 acres of Billy Fuels Reduction Projects, including Billy Grunt and Billy Mastication, using pre-commercial thinning and mastication treatments were completed and continue to be planned within the 50-year old Donner Fire plantations. These projects, which reduced the canopy of over-dense shrubs and trees, benefitted early and mid-seral species, such as mountain quail and deer,

by rejuvenating decadent, overgrown shrubs and providing travel corridors through homogeneous shrub thickets. These treatments also reduced the fire hazard risk by breaking up continuous fuel loadings.

Present and Reasonably Foreseeable Future Projects

The Phoenix (Koruna and Lira), Sagehen, Transition, Independence Lake, and Dry Creek Projects (4,520 acres) commercial thinning projects would all have similar short-term impacts to wildlife habitat quality by reducing overstory tree cover as well as reducing understory complexity with the overall objective of reducing fire risk hazard to forests and wildlife habitats. However, maintaining large trees, retention of moderate to high canopy cover and snags and down logs would continue to be key management objectives for long-term sustainability of mature forest species and their habitats across the landscape.

General Cumulative Effects Summary

The Sagehen Project would utilize a wide variety of innovative vegetation treatments utilizing concepts presented in "An ecosystem management strategy for sierra mixed-conifer forests" aka GTR-220 (North et al. 2009) and "Managing Sierra Nevada Forests" or GTR-237 (North et al. 2012), which strive to enhance forest heterogeneity and resiliency by using topography, slope, and aspect to develop treatments that are in concert with natural fire disturbance regimes while integrating wildlife habitat objectives. The Sagehen Project would result in some short-term reduction in habitat quality for some species while enhancing forest diversity and resiliency at the stand and landscape scale. Dense cover areas, snag girdling and short snag creation would all retain and enhance vegetation conditions for species such as the marten, that have experienced population declines within the Basin and the Sierra Nevada mountains as a whole (Moriarity et al. 2011, Zielinski 2012). Compared to the no action alternative and Alternative 3, Alternative 1 best meets the intent to improve forest diversity, resiliency for wildlife in the long-term. Alternative 2 would not add to cumulative effects since habitats would be unaltered, however, actions to reduce fire risk and increased forest resiliency and heterogeneity would not be realized. Alternative 3 would result in the less cumulative effects to wildlife habitats than Alternative 1, but also would not be as effective at meeting all the ecological restoration objectives, including enhancing wildlife habitats within the Basin. Alternative 1, while adding the most cumulative effects (2,750 acres) would result in short term reduction in habitat quality for old forest species, but would best meet long-term objective for providing sustainable wildlife habitats, reducing fuels risk, and achieving forest ecosystem restoration within the analysis area.

Species Specific Cumulative Effects

BALD EAGLE

Status: USFS R5 Sensitive

Within the 29,467 cumulative effects boundary, there is one known bald eagle nest territory located at the west end of Independence Lake. This territory occurs approximately 2 miles from the nearest treatment units. Cumulative effects to bald eagles from implementing Alternatives 1 or 3 would

negligible both in scope and intensity, and would only affect incidental bald eagles foraging or passing through the area. No known nesting bald eagles occur within or adjacent to project units. Therefore, the Independence Lake bald eagle territory would not be affected by project alternatives, since project units are located over 2 miles away.

CALIFORNIA SPOTTED OWL

Status: USFS R5 Sensitive

Past, present, and reasonably foreseeable future projects and their effects on wildlife habitat, were described in the section *Cumulative Effects Common to All Wildlife*, which also applies to the spotted owl. Past projects' effects on owl habitat are difficult to assess, particularly since the importance of spotted owls on the east side of Tahoe NF and within the Sagehen Basin is not well-understood. Generally, habitat within the analysis area does not provide optimum spotted owl habitat types and conditions when compared to spotted owl distribution on the Tahoe NF. The majority of spotted owl territories on the Forest are located in westside mixed conifer types at lower elevations (i.e. Sierra mixed conifer dominated by ponderosa pine, Douglas fir, white fir, incense cedar, and black oak) with a higher proportion of large tree density and higher canopy cover.

However, the analysis area has been occupied by a single spotted owl territory, since 1998. The vegetation where the territory is located likely represents some of the highest quality late seral habitat within the Basin. It is unknown how this owl territory contributes to the overall owl population on the Tahoe NF as reproductive success of this territory has been uncertain. Perhaps the lack of large, continuous high quality owl habitat limits its reproductive output. It has been suggested that the lack of high quality habitat within the home range of the spotted owl increases home range size, increases energy expenditure, and may lead or contribute to lower reproductive success or fitness. Based on low quality or marginal spotted owl habitat available in the Sagehen area and its location on the eastside of the Sierra Nevada crest, these owls may represent sink populations according to Verner et al. (1992). In general, past timber harvest projects contributed to reducing overall habitat quality and quantity within the analysis area, as well as the conversion of mature forests to early seral forests resulting from the 1960 Donner Ridge Fire.

Vegetation management on both private and Forest Service lands, during the 1980s through the 1990s, resulted in extensive habitat modification of suitable nesting, roosting, and foraging owl habitat from select tree, seed tree, and clearcut harvests. These types of treatments resulted in the removal of approximately 4,729 acres of suitable nesting and foraging habitat (now in an early seral condition). In addition, snag removal during broad-scale salvage operations of the 1990's occurred though out the Basin on over 2,000 acres, which ultimately caused the reduction in available nesting and foraging structures. Past projects (i.e. Sagehen/Spring Chicken Fuelbreaks (576 acres), Liberty/Stampede/Zingara (504 acres), and others for a total of 1,215 acres) that implemented thinning from below rendered suitable habitat quality lowered or in some cases may have been reduced in the amount of nesting and foraging habitat quality in the short-term. Although many of the treatments have since recovered in

canopy cover densities and tree size, the structural diversity has been simplified without multi-layered condition in many areas, and without decadent standing and down wood features. Furthermore, significant spotted owl nesting and roosting habitat was likely lost from wildfires including the stand-replacing 1960 Donner Ridge Fire (9,587 ac), 1960 unnamed fire (46 ac), 1968 Sagehen Fire (152 ac), and the 1926 Independence Fire (2,653 acres).

This section will focus specifically on cumulative effects of the Sagehen Project alternatives combined with the effects of past, present, and reasonably foreseeable future activities on suitable spotted owl nesting and foraging habitat by changes to CWHR habitat types from treatment effects. For specific project descriptions, refer to the section on Cumulative Effects to All Species.

Past regeneration harvests (662 acres on Forest Service lands and an estimated 4,443 acres on private lands) resulted in long-term reductions in moderate quality nesting, roosting, and foraging habitat (change to unsuitable habitat). While the not every acre harvested comprised this high quality habitat prior to harvest, one can assume that a moderate proportion of the harvested area would have been occupied by larger trees and had higher canopy cover levels characteristic of suitable nesting and roosting habitat. While high quality nesting habitat was likely removed from these regeneration harvests of the past, the amount and quantity of high quality nesting habitat (CWHR 5M, 5D, 6) that was affected was likely dependent on the distribution of vegetation types within and surrounding the Basin. Areas that were dominated by more open eastside pine types were not likely preferred for nesting by owls. Whereas, areas that were historically comprised of true fir types were likely to provide larger trees and denser canopy cover levels that are suitable for nesting.

Present and future projects would not result in the loss or reduction in the quantity of nesting/roosting habitat. The Independence THP (19 ac) and Transition Project (14 ac) would reduce suitable nesting habitat quality on 33 acres in the short-term from the reduction in canopy cover, however no changes to tree size class would occur. The Sagehen Project action alternatives would not contribute to adding cumulative effects to suitable spotted owl nesting habitat, as none of the treatments are proposed within suitable owl nesting habitat (CWHR 5M, 5D, 6). Given the overall low habitat quality and relatively lack of suitable nesting habitat within the Basin and analysis area, cumulatively affecting 32 (<0.1%) acres would likely be inconsequential to spotted owls considering there is only one spotted owl territory within the 29,467-acre analysis area. In addition, both the Transition and Independence Lake projects are in the northern portion of the analysis area located several miles from the known spotted owl territory.

Past project treatments (Sagehen/Spring Chicken Fuelbreaks, Liberty, Zingara, Stampede, and others) resulted in the reduction in the quality of spotted owl foraging habitat within the analysis area. For the most part, those treatments have likely recovered in canopy cover to pre-treatment levels. However, depending on the intensity of treatments, some areas may still have very open understories, such as the fuelbreaks or defensive fuel profile zones and may be lacking dead and down wood. Approximately 982 acres from present and future projects would reduce the quality of spotted owl foraging habitat in the short-term, but would not result in the loss of foraging habitat. Alternative 1 and 3 would cumulatively add 1,280 and 112 acres, respectively to past, present, and reasonably foreseeable future actions that

have reduced the quality of owl foraging habitat. Under Alternative 1, current unit average canopy cover ranges from 51% to 80% and post-treatment average canopy cover would range from 41% to 71%. The average unit canopy cover for Alternative 3 currently ranges from 51% to 76%. Average canopy cover for the units following treatments under Alternative 3 would range from 41% to 71%. Alternative 2, no action, would not add to existing cumulative effects to the spotted owl or its habitat within the analysis area. However, forest resiliency, forest heterogeneity, and reduced fuels hazard would not be achieved under the no action alternative. While there are a number of past, present, and future projects resulting in short-term reductions in the quality of suitable foraging habitat, the additional short-term reductions under the action alternatives would not result in substantial adverse cumulative effect on foraging habitat, particularly since no foraging habitat would be removed.

GREAT GRAY OWL

Status: USFS R5 Sensitive

Since great gray owls have not been confirmed to nest within the analysis area, Alternatives 1 and 3 would have a low probability of adding to existing cumulative effects to the great gray owl. It is unknown if the great gray owl historically nested within and adjacent to the Basin. Due to the limited amount of suitable great gray owl habitat that would be affected in treatments (Units 98 and 100), and considering that this species has not been documented to nest in the vicinity, cumulative effects would be minimal to nonexistent.

NORTHERN GOSHAWK

Status: USFS R5 Sensitive

Past, present, and reasonably foreseeable future projects and their effects on wildlife habitat, were described in the section *Cumulative Effects Common to All Wildlife*, which also applies to the Northern goshawk.

Vegetation management on both private and Forest Service lands, during the 1980s through the 1990s, resulted in extensive habitat modification of suitable nesting, roosting, and foraging goshawk habitat from select tree, seed tree, and clearcut harvests. These types of treatments resulted in the removal of approximately 4,729 acres of suitable nesting and foraging habitat (now in an early seral condition). In addition, snag removal during broad-scale salvage operations of the 1990s occurred thoughout the Basin on over 2,000 acres. Past projects (i.e. Sagehen/Spring Chicken Fuelbreaks (576 acres), Liberty/Stampede/Zingara (504 acres), and others for a total of 1,215 acres) that implemented thinning from below rendered suitable habitat quality lowered or in some cases may have been reduced in the amount of nesting and foraging habitat quality in the short-term. Although many of the treatments have since recovered in canopy cover densities and tree size, the structural diversity has been simplified without multi-layered condition in many areas, and without decadent standing and down wood features. Furthermore, significant suitable nesting and foraging habitat was likely altered from wildfires including the stand-replacing 1960 Donner Ridge Fire (9,587 ac), 1960 unnamed fire (46 ac), and 1968 Sagehen Fire (152 ac), and the 1926 Independence Fire (2,653 ac).

This section will focus specifically on cumulative effects of the Sagehen Project alternatives combined with the effects of past, present and reasonably foreseeable future projects on suitable goshawk nesting and foraging habitat by changes to CWHR habitat types from treatment effects. For specific project descriptions, refer to the section on Cumulative Effects to All Species.

Past regeneration harvests (662 acres on Forest Service lands and an estimated 4,443 acres on private lands) resulted in long-term reductions in high and moderate quality nesting, roosting, and foraging habitat (change to unsuitable habitat). While the not every acre harvested comprised this high quality habitat prior to harvest, one can assume that a substantial proportion of the harvested area would have been occupied by larger trees and had higher canopy cover levels characteristic of suitable nesting and roosting habitat. While high quality nesting habitat was likely removed from these regeneration harvests of the past, the amount and quantity of high quality goshawk nesting habitat that was affected was likely dependent on the distribution of vegetation types within and surrounding the Basin.

Past project treatments (Sagehen/Spring Chicken fuel breaks, Liberty, Zingara, Stampede, and others) resulted in the reduction in the quality of goshawk foraging habitat within the analysis area. For the most part, those treatments have likely recovered in canopy cover to pre-treatment levels. However, depending on the intensity of treatments, some areas may still have very open understories, such as the fuel breaks or defensive fuel profile zones and may be lacking dead and down wood. A total of 3,766 acres of suitable goshawk habitat (2,522 acres nesting habitat, 1,244 acres foraging habitat) would be reduced in quality in the short-term from present and reasonably future projects (i.e. thinning and fuels reduction), but would not result in the reduction in quantity of suitable goshawk habitat. The Sagehen Project would add 2,590 acres (nesting - 1,792 acres, foraging - 798 acres) and 1,132 acres (704 acres – nesting, 391 acres – foraging) for Alternative 1 and 3, respectively to past cumulative effects to suitable nesting and foraging goshawk habitat. Under Alternative 1, current unit average canopy cover ranges from 51% to 80% and post-treatment average canopy cover would range from 41% to 71%. The average unit canopy cover for Alternative 3 currently ranges from 51% to 76%. Average canopy cover for the units following treatments would range from 41% to 71% under Alternative 3.

Alternative 2, No Action, would not add to existing cumulative effects to the goshawk or its habitat within the analysis area. However, forest resiliency, forest heterogeneity, wildlife habitat structural diversity, and reduced fuels hazard would not be achieved under the No Action Alternative. Therefore, long-term threats of wildfire risk to goshawk suitable habitat within and surrounding PACs would not be reduced under Alternative 2.

WILLOW FLYCATCHER

Status: USFS R5 Sensitive

Effects of past, present, and reasonably foreseeable activities to willow flycatcher include changes to hydrologic condition of meadows and riparian willow habitat from fire suppression and historic grazing. Although, long-term declines in willow flycatcher populations have been documented across the Sierra Nevada Bioregion, historical declines to the population have been attributed to loss of habitat and changes to habitat condition. Fire suppression in the last 100

years could potentially have altered the hydrologic condition of willow flycatcher meadow and willow habitats, where increased conifer competition for water resources lead to the drying of meadows. The Sagehen Creek area has not been grazed since the mid-1990s, but portions of the meadows along Sagehen Creek appear to have experienced some drying out which may be attributed to the increase in conifer encroachment (primarily lodgepole pine) into the meadows. The Sagehen Allotment was closed in 2008, but had not been consistently grazed since the early 1990's. Past sheep grazing along Sagehen Creek likely had little affect from sheep grazing, particularly since sheep grazing was primarily located within the uplands and did not concentrate in the riparian areas. In general, the habitat within the Sagehen Creek area is not high quality compared to sites that have a history of long-term occupancy by willow flycatchers, such as at Independence Lake and Carpenter Valley, which are characterized by large, wet meadow systems with a significant willow component. These two willow flycatcher sites are located outside of the Sagehen Basin. None of the proposed actions for the Sagehen Project under Alternatives 1 and 3 would add measureable effects to existing cumulative effects to the willow flycatcher, since the disturbance effects from proposed treatments would be short-term and minimal in scope and intensity. Thinning forests adjacent to meadow and willow habitats as proposed for Alternatives 1 and 3 could potentially benefit willow flycatcher in the long-term by reducing the competition for water resources from conifers encroaching onto meadow areas, and may benefit from the reduced risk of habitat loss to wildfires.

The Independence Lake site is outside of the existing Independence Allotment and is not being grazed. The Carpenter Valley site is within the Euer Allotment, which is predominantly comprised of private land. Currently, the Euer Allotment is vacant and has not been grazed by livestock since the early 2000's. It is not likely that current willow flycatcher habitat conditions is still experiencing affects from past grazing practices, or have likely recovered, at least for the Independence and Sagehen Creek sites. Since, the Carpenter Valley site is on private land, the habitat condition or grazing effects are unknown. Present and reasonably foreseeable future projects listed in would not likely add to existing cumulative effects to willow flycatchers at Sagehen Creek, Independence Lake, or at Carpenter Valley, since willow flycatcher habitat would not be affected by proposed vegetation management activities, including the Independence Lake THP and others.

PACIFIC MARTEN

Status: USFS R5 Sensitive

Past, present, and reasonably foreseeable future projects and their effects on wildlife habitat, were described in the section Cumulative Effects Common to All Wildlife, which also applies to the Pacific marten.

Vegetation management on both private and Forest Service lands, during the 1980s through the 1990s, resulted in extensive marten habitat modification from select tree, seed tree, and clearcut harvests. These types of treatments resulted in the removal of approximately 4,729 acres of high and moderate quality marten habitat (now in an early seral condition). Moriarity et al. 2011 suggested that marten population declines within the Sagehen Basin coincided with this period of intensive timber harvest,

including the Golden Timber Sale. In addition, snag removal during broad-scale salvage operations of the 1990s occurred throughout the Basin on over 2,000 acres. Past projects (i.e. Sagehen/Spring Chicken Fuelbreaks (576 acres), Liberty/Stampede/Zingara (504 acres), and others for a total of 1,215 acres) that implemented thinning from below rendered suitable habitat quality lowered or in some cases may have been reduced in the amount of denning and foraging habitat quality in the short-term. Although many of the treatments have since recovered in canopy cover densities and tree size, the structural diversity has been simplified without multi-layered condition in many areas, and without decadent standing and down wood features. Furthermore, significant suitable nesting and foraging habitat was likely altered from wildfires including the stand-replacing 1960 Donner Ridge Fire (9,587 ac), 1960 unnamed fire (46 ac), and 1968 Sagehen Fire (152 ac), and the 1926 Independence Fire (2,653 ac).

Past regeneration harvests (662 acres on Forest Service lands and an estimated 4,443 acres on private lands) resulted in long-term reductions in high and moderate quality marten denning, foraging, and resting habitat. This is supported by Moriarty et al. (2011) that showed a decrease in habitat patch size, core habitat areas, and total amount of habitat available within the Sagehen Basin. While not every acre harvested comprised this high quality habitat prior to harvest, one can assume that a substantial proportion of the harvested area would have been occupied by larger trees and had higher canopy cover levels characteristic of suitable denning habitat. While high quality marten habitat was likely removed from these regeneration harvests of the past; the amount and quantity of high and moderate quality marten habitat that was affected was likely dependent on the distribution of vegetation types within and surrounding the Basin.

Past project treatments (Sagehen/Spring Chicken fuel breaks, Liberty, Zingara, Stampede, and others) resulted in the reduction in the quality of suitable marten habitat within the analysis area. For the most part, those treatments have likely recovered in canopy cover to pre-treatment levels. However, depending on the intensity of treatments, some areas may still have very open understories, such as the fuel breaks or defensive fuel profile zones and may be lacking dead and down wood. Approximately 555 acres of suitable marten habitat (426 acres high quality habitat, 129 acres moderate quality habitat) would be reduced in quality in the short-term from present and reasonably future projects (i.e. thinning and fuels reduction), but would not result in the reduction in quantity of suitable marten habitat. The Sagehen Project would add 775 acres of suitable high and moderate quality habitat (232 acres – high quality, 544 acres - moderate quality) for Alternative 1 and 3, respectively to past cumulative effects to high and moderate quality marten habitat. Under Alternative 1, current unit average canopy cover ranges from 51% to 80% and post-treatment average canopy cover would range from 41% to 71%. The average unit canopy cover for Alternative 3 currently ranges from 51% to 76%. Average canopy cover for the units following treatments would range from 41% to 71% under Alternative 3.

Alternative 2, No Action, would not add to existing cumulative effects to the marten or its habitat within the analysis area. However, forest resiliency, forest heterogeneity, habitat structural diversity, snag enhancement and reduced fuels hazard would not be achieved under the No Action Alternative. Therefore, long-term threats of wildfire risk to high and moderate quality marten suitable habitat would not be reduced under Alternative 2. Potential wildfire threats under the No Action Alternative could

result in increased habitat fragmentation should a stand-replacing wildlfire event were to occur within the Sagehen Basin.

CALIFORNIA WOLVERINE

Status: USFS R5 Sensitive, USFWS Proposed

Present, and reasonably foreseeable actions would not likely add measureable effects to past cumulative effects, since habitat modification, including forest thinning and fuels reduction projects do not appear to affect the distribution of the species, since wolverine have large home ranges and inhabit a broad array of habitat types. Furthermore, there is no scientific evidence that land management activities, including forest management and prescribed burning would affect the abundance or distribution of the species (USDI Fish and Wildlife Service 2013). The Sagehen Project, as proposed, would not add to existing cumulative effects, except for an extremely, low potential to directly disturb the wolverine during project activities. However, since the proposed Sagehen Project activities would encompass less than 2 percent of the known wolverine's home range, the likelihood of this occurring would be unexpected. The proposed treatments of the action alternatives would not likely add to existing cumulative effects, since forest management is not likely to adversely affect the wolverine.

Management Indicator Species

The following cumulative effects analysis for Management Indicator Species (MIS) is based on the project MIS report previously incorporated by reference and available by request from the Tahoe National Forest.

Early and Mid Seral Coniferous Forest Habitat (Mountain Quail)

Alternative 1 (Proposed Action): Past projects have generally led to a net increase in early and mid seral habitat. This increase in habitat is reflected in what is currently present today. Present projects and the proposed project would reduce 6 acres of mid seral habitat as a result of type conversion to aspen. The Early Seral Opening treatment proposed to occur on a total of 54 acres under Alternative 1 would likely result in a small net increase in habitat. However, this potential increase of 54 acres is in approximate ½ acre size openings scattered across the treatment units. The openings themselves would not change the surrounding stand CWHR type. Thus the analysis above does not reflect the net increase because the scale is too small to be reflected in the stand CWHR types. One future project currently in the planning phase is not expected to affect early and mid seral habitat. The slight effects of current and the proposed project when added to past and reasonably foreseeable projects would not result in long term adverse cumulative effects to early and mid seral MIS mountain quail habitat.

Alternative 2 (No Action): Past projects in the larger analysis area have generally led to a net increase in early and mid seral habitat. This increase in habitat is reflected in what is currently present today. Present projects would reduce 1 acre of mid seral habitat as a result of type conversion to aspen. One future project currently in the planning phase is not expected to affect early and mid seral habitat. Natural growth would result in some areas having trees that reach larger sizes and therefore reduce

early and mid seral habitat over time. Increased risk of natural disturbances would result from taking no action. Accurately quantifying the probability and extent of effects is problematic but some increase in habitat is likely The slight reduction of 1 acre of MIS habitat as a result of current projects when added to the effects of Alternative 2, past, and reasonably foreseeable projects would not result in long term adverse cumulative effects to early and mid seral MIS mountain quail habitat.

Alternative 3(Non-Commercial Funding): Past projects have generally led to a net increase in early and mid seral habitat. This increase in habitat is reflected in what is currently present today. Present projects would reduce 1 acre of mid seral habitat by type conversion to aspen. One future project currently in the planning phase and Alternative 3 is not expected to affect early and mid seral habitat. The slight effects of current projects when added to Alternative 3, past, and reasonably foreseeable projects would not result in long term adverse cumulative effects to early and mid seral MIS mountain quail habitat.

Cumulative Effects at the Bioregional Scale: Cumulative effects and the effects of the proposed alternatives have and would alter overstory canopy cover and shrub canopy cover but would not alter the habitat in such a way that would cause it to be unsuitable to mountain quail. An increase in habitat was created from past projects and a small number of acres would be changed from early or mid seral habitat into an aspen vegetation classification from current projects and the proposed project. The small reduction in acres of early and mid seral mountain quail habitat (6 acres of the 3,306,873 acres of habitat on National Forest System lands in the Sierra Nevada) would not alter the existing trend in habitat, nor would it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion. Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, Pacific marten, and northern flying squirrel)

Alternative 1(Proposed Action): Alternative 1 is expected to reduce the CWHR canopy cover classification from a “D” to an “M” on 1.5 acres of late seral closed-canopy coniferous habitat type. This is in addition to the 3 acres from current projects that would also change the canopy cover classification from a “D” to an “M”. These changes however would not affect the amount of late seral closed-canopy MIS habitat available as the canopy cover that would remain in these areas is still designated as habitat for the selected species. There would be no net change in the amounts of late seral closed-canopy forest and no cumulative effect. Large down logs and large snags would increase as a result of past, present, reasonably foreseeable future projects, and the proposed project. Although past projects reduced habitat, the present, future, and the proposed project combined will maintain the existing habitat, and will help develop important habitat components of large down logs and snags. Therefore, the Sagehen Project Alternative 1 would not result in long term adverse cumulative effects to late seral closed-canopy coniferous forest habitats.

Alternative 2 (No Action): Alternative 2 would have no effect on late seral closed-canopy coniferous habitat because no action would be taken. Large down logs and large snags would increase as a result

of past, current, and reasonably foreseeable future projects. Alternative 2 would maintain snag and down log recruitment at its current level in the project area. The slight increase in large snags and down logs as a result of past, present, and reasonably foreseeable future actions along with no change as a result of Alternative 2, would result in a mortality rate which is estimated to be unsustainable over the long term. The reduction in habitat from past projects along with the present, future, and Sagehen Project Alternative 2 maintaining the same amount of habitat would not result in long term adverse cumulative effects to late seral closed-canopy coniferous forest habitats but may result in adverse cumulative effects to the large snag and large down log habitat attribute of the selected species.

Alternative 3 (Non-Commercial Funding): The proposed treatment areas for Alternative 3 do not contain late seral closed-canopy coniferous forest habitat and would therefore not have an effect to this habitat type. The cumulative effects for Alternative 3 are the same as for the No Action Alternative (Alternative 2) above.

Cumulative Effects at the Bioregional Scale for California spotted owl, Pacific marten, and Northern flying squirrel: Implementation of the proposed project alternatives would not reduce late seral closed-canopy habitat, would retain current large snags and large down wood, and would create a condition that would increase the amount of large snags and down wood in the future (under Alternative 1). The Sagehen Project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of these species across the Sierra Nevada bioregion. Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

Snags in Green Forest Ecosystem Component (Hairy woodpecker)

Alternative 1 (Proposed Action): While past treatments have both, reduced existing snag densities and reduced tree competition (which has resulted in trees growing larger and creating larger snags), effects of past treatments are primarily reflected in current conditions where in untreated areas snag recruitment is at unsustainable levels. Densities of snags in the medium and large size categories would generally still increase as a result of the present, future, and proposed projects, with the potential exception of 22 acres of fuelbreak treatments on private land. This reduction is not expected to have a substantial negative effect in the larger analysis area due to the limited number of acres affected. Although combined the present and proposed actions would decrease the rate at which snags are created, the overall result is expected to be beneficial as larger snags (>15”dbh) would be created in the long term. Alternative 1 would not remove any current snags greater than or equal to 15 inches dbh, and would add an additional 1-3 snags (via partial girdling) per acre in areas determined to have snag densities below desired conditions. The slight increase in snag densities of medium and large snags as a result of the proposed, past, present, and reasonably foreseeable future actions would not result in long term adverse cumulative effects to the snags in green forest MIS habitat attribute of the hairy woodpecker, rather would be a beneficial effect.

Alternative 2 (No Action): Densities of snags in the medium and large size categories would increase as a result of past, present and future projects. Although past, present, and future projects would decrease the rate at which snags are created, the overall result is expected to be beneficial as larger snags (>15"dbh) would be created in the long term. Alternative 2 would retain medium and large snag density and recruitment at its current level which is estimated to be unsustainable in the project area. The slight increase in snag densities of medium and large snags as a result of past, present, and reasonably foreseeable future actions along with no change as a result of Alternative 2, would result in an unsustainable amount of tree mortality in untreated areas. Maintaining current levels of snag recruitment may have long term adverse cumulative effects to the snags in green forest MIS habitat attribute of the hairy woodpecker.

Alternative 3 (Non-Commercial Funding): Snag recruitment in the medium and large size categories in Alternative 3 treated units, and current projects would increase at a slower rate than undisturbed areas. Although a reduction in snag recruitment rate would occur, the result is expected to be beneficial as larger snags (>15"dbh) would be created in the long term as a result of improved forest health. This beneficial effect would occur on fewer acres as compared to Alternative 1. The slight increase in medium and large snag density from past, present, and reasonably foreseeable future actions along with effects of Alternative 3 would not result in long term adverse cumulative effects to the snags in green forest ecosystem component.

Cumulative Effects at the Bioregional Scale: Implementation of the proposed project alternatives would retain current medium and large snags, and would create a condition that would increase the amount of medium and large snags in the future. The Sagehen Project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of the hairy woodpecker across the Sierra Nevada bioregion. Cumulative effects at the bioregional scale are tracked via the SNF MIS Bioregional monitoring, and detailed in the 2010 SNF Bioregional MIS Report (USDA Forest Service 2010a).

Aquatic Wildlife

This section of the EA summarizes the cumulative effects analysis from the Aquatic Biological Evaluation (BE) and also draws upon information from the *Sagehen Project Hydrology Report* and *Cumulative Watershed Effects Analysis*. The alternatives of the Sagehen project in combination with other past, present and future actions on the National Forest and private lands within the Sagehen Aquatics Analysis Area were considered. The following analysis considers the cumulative effects resulting from implementation of the Sagehen Project Action Alternatives, Alternative 1 and Alternative 3. The No Action Alternative, Alternative 2, would have no cumulative effects beyond existing trends as no activities are proposed under that alternative. Therefore, cumulative effects under Alternative 2 are not analyzed further.

The spatial extent of the cumulative effects analysis area for aquatic wildlife will include the Lower Sagehen and Upper Sagehen Creek Watershed Catchments which comprise approximately 10,412 acres. Private lands within the Sagehen Project area account for approximately 9% of the

total area. The analysis area was chosen since it considers the riparian habitats associated with the proposed Sagehen Project, and the overall condition of the watersheds that the species within this project area may inhabit. The temporal boundary for the effects analysis will include the timeframe from 1880 to 2025. The year 1880 was chosen due to the historic land management activities whose effects may be continuing at present, e.g. logging operations which altered hydrology in 1880's that likely contributed to the channel conditions of Sagehen Creek and its tributaries, and the construction and operations of dams below the project area which likely influenced species distribution. The future extent of 2025 was selected as it should encompass effects from the planned Sagehen Project.

Numerous past, present and future activities or natural events have had or may have negative impacts on the Aquatic Analysis Area's watersheds and riparian area habitats, including the following: (1) railroads, (2) timber management, (3) grazing, (4) roads, (5) fire, (6) recreation, and (7) severe climatic events. The past activities, from 1880-present, are relevant because their effects are still evident, and sometimes active, today. Related to aquatics, these effects are primarily visible in stream channel and riparian zone conditions, rather than known changes in species health or population size. A quantifiable metric, such as acres/miles of suitable aquatic habitat, is not available for past cumulative effects. Therefore the majority of past cumulative effects will be described qualitatively, rather than quantitatively.

Past and Present Cumulative Effects

Past activities, such as dam construction, are known to have dramatically affected both the distribution and population sizes of fishes, and the habitat for all aquatic species. More recent effects are primarily visible in stream channel and riparian zone conditions, rather than known quantitative changes in species distribution or population size. Present cumulative effects to aquatic species and habitat generally differ in magnitude from past cumulative effects due to changes in management over time. The attributes in Table 3.26 describe the existing condition of three important stream habitat attributes that were likely shaped by the cumulative effects discussed in this document.

Table 3.26: Stream habitat attributes and quality categories within Sagehen Project Aquatics Analysis Area.

Bank Instability	High	Moderate	Low (desired)
Total Reach Miles Rated	1.78	4.68	7.43
% of Total Miles Surveyed	13%	34%	53%
Fine Sediment	**High**	**Moderate**	**Low (desired)**
Total Reach Miles Rated	2.04	8.12	3.74
% of Total Miles Surveyed	15%	58%	27%
Coarse Woody Debris	**Low**	**Moderate**	**High (desired)**
Total Reach Miles Rated	9.44	4.46	0
% of Total Miles Surveyed	68%	32%.	0%

The above conditions are not attributable to a single management activity or natural event. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Focusing on the impacts of past human actions risks ignoring the important residual effects of past natural events which may contribute to cumulative effects just as much as the human actions. By looking at current conditions, we are sure to capture all the residual effects of past human and natural events, regardless of which particular action or event contributed those effects.

Cumulative Effects Future

Future effects from the activities or events listed below have been considered in determining cumulative effects to potentially affected species.

Railroads: In the absence of active removal, railroad grades within the analysis area may continue to produce negative effects to stream habitat, such as unstable banks and the alteration of drainage patterns may continue into the foreseeable future. Restoration projects improving degraded conditions attributable to railroad grades may be proposed in the future, but are not actively being planned at this time. Such restoration projects have been implemented in other locations of the Tahoe National Forest.

Timber Management: The Tahoe National Forest plans to continue with timber harvest, fuels management and ecological restoration projects. Projects which are currently active or planned within RCAs within the Aquatics Analysis area include: Billy Mastication (85 acres Ephemeral, 42 acres Intermittent, and 7.5 acres SAF) Transition (16.3 acres Ephemeral, 1.9 acres SAF) and on private lands; Independence Lake Forest Thinning and Fuels Reduction Project THP (11.5 acres Ephemeral, 17.5 acres SAF). Additional projects, with treatments similar to the Sagehen Project, will likely continue into the future. The Sagehen Project would probably begin implementation in 2014, and will likely be active through 2025. This project is focused within the Sagehen watershed which is associated with known populations of Sierra Nevada yellow-legged frogs and their habitat. The Sagehen project will include management activities within RCAs. With proper implementation of prescribed SMRs and BMP's (Appendix A), no significant effects to aquatic habitat are predicted.

Livestock Grazing: Active grazing within the Sagehen allotment was discontinued in 1996; the allotment was for sheep. An Environmental Assessment for the allotment was completed in 2005; the resulting decision permanently removed the allotment from grazing activity. The area has largely recovered from grazing effects.

Road Construction and Maintenance: The existing roads in the analysis area have had widespread effects on aquatic resources, including the creation of fish/amphibian migration barriers, loss of near-stream vegetative cover, unstable stream banks, and increased input of fine sediments. A Roads Analysis has been completed for the Sagehen Project which provides a more

detailed and quantitative history of the road network and its effects. The continuing evaluation, and subsequent improvements and maintenance of the existing road network should yield positive future effects through 2025. Some expected benefits to aquatic organisms include: improved habitat connectivity through culvert removal and upgrades, and reduced bank instability and fine sediment input through drainage improvements and road closures.

Fire: The reduction of future severe wildfires is one of its most important goals on National Forests, and influences the majority of project design elements. Future success in meeting this goal should reduce fire-related aquatic habitat impacts such as large alterations of riparian vegetation, large changes in the physical and chemical properties of water, bank instability, and input of fine sediments.

Recreation: The Sagehen Basin is not a high use recreation area. However, ongoing recreational activities affect aquatic organisms and their habitat within the Sagehen Project area, some of which include: fish stocking, recreational fishing, hunting, off-highway vehicle use and camping. It is possible that fish stocking is still affecting native fish and amphibians, though effects are probably much smaller than in the past due to re-evaluation of stocking practices by the California Department of Fish and Game. Recreational activities primarily affect aquatic habitat, rather than species directly. Effects to habitat include: reduction in near-stream cover, unstable stream banks, reduction of undercut banks, and increased input of fine sediments. Though the majority of these habitat effects occur over geographically small areas, cumulatively their impacts may contribute to current conditions. The Tahoe National Forest is currently in the process of designating official OHV routes, which should result in better road/trail maintenance, and closure of highly impacted areas.

Severe Climatic Events: Future severe climatic events will likely alter aquatic habitat in the Sagehen Project area, as they have in the past. Most relevant to aquatic resources are droughts and floods. It is likely that the cycles of drought and flood have caused large changes in the distribution and population sizes of most aquatic organisms, and will continue to do so into the foreseeable future. Because of this, habitat connectivity is crucial in allowing for re-colonization of areas expunged of their native aquatic fauna. Drought events generally cause declines in distribution and population sizes, while flood events can either increase or decrease distribution and population sizes. Stream habitat attributes are often altered substantially by flood events. Stream health can be negatively affected by severe floods, with the bank stability indicator being most susceptible. Flood events can be beneficial for the input of coarse woody debris. Severe climatic events, such as flood and/or drought, could occur in the project area through 2020. If these events occur, it is likely that observable changes to aquatic species and their habitat will take place, as they have in the past. These changes, and the existing condition, will be considered when designing future projects.

Species Specific Cumulative Effects

LAHONTAN CUTTHROAT TROUT (Oncorhynchus clarki henshawi)

Status: USFWS Threatened

The severe decline in range and numbers of Lahontan cutthroat trout (LCT) is attributed to a number of factors including hybridization and competition with introduced trout species; alteration of stream channels and morphology; loss of spawning habitat due to pollution and sediment inputs from logging, mining, grazing and urbanization; migration blockage due to dams; reduction of lake levels and concentrated chemical components in natural lakes; loss of habitat due to channelization; de-watering due to irrigation and urban demands; and overfishing (Gerstung 1986 & 1988, Coffin 1988, USDI Fish and Wildlife Service 1995).

LCT evolved in the absence of other trout species and do not compete well for food and habitat. In stream environments within the western portion of the Lahontan drainage, LCT have seldom been able to co-exist with non-native trout for longer than a decade. LCT, particularly those within the western portion of the Lahontan Basin, also hybridize with rainbow trout (Behnke 1979). Lahontan cutthroat trout have been introduced into habitats outside of its native range, primarily for recreation fishing purposes. In addition, LCT have been re-introduced into the Truckee River for recreation. These recreation related populations are not considered recovery populations by the USFWS and are not subject to protection under the Endangered Species Act.

Potential risk factors to the LCT include the immediate loss of individual fish and loss of specific habitat features such as undercut banks used for cover, increases in sedimentation leading to changes in spawning bed capacity, and the loss of riparian vegetation necessary to maintain adequate temperature regime (SNFPA 2001).

As stated in the analysis of direct and indirect effects to LCT earlier in Chapter 3 under FONSI Element #1, the species is absent from the analysis area, and project activities, including temporary road building, will not occur near extant LCT populations. The location and treatment types within RCAs have been considered and the possibility of effects to the stream channel condition is not considered significant. If project effects occur they would be minimal and would not occur within occupied LCT habitat. Therefore, no cumulative effects to LCT or occupied LCT habitat would occur under any of the Alternatives. Cumulative effects from Sagehen Project Alternatives to suitable unoccupied LCT habitat should be minimal due to standard management requirements and RCA protection measures integrated within the Sagehen Project.

SIERRA NEVADA YELLOW-LEGGED FROG (Rana sierra)

Status: USFS R5 Sensitive, USFWS Candidate (Sierra Nevada DPS)

As previously stated in the effects analysis for MYLF in Chapter 3 under FONSI Element #1, the Sierra Nevada yellow-legged frog (MYLF) was once abundant in aquatic ecosystems of the mid to high elevation Sierra Nevada from southern Plumas County to southern Tulare County and has undergone a range-wide decline in the Sierra Nevada with 90% of historical MYLF sites now unoccupied. As noted, the reasons for the decline include introduction of salmonid fishes, chytridiomycosis disease, air borne pesticides, alteration and loss of habitat and grazing. MYLF frogs are known to have been present within

a number of locations in Tahoe National Forest, but now exist in only a few populations in ponds and streams and generally in small numbers (USDI Fish and Wildlife Service 2003, Tahoe National Forest GIS database).

Sierra Nevada yellow-legged frog populations are generally considered to exhibit characteristics typical of metapopulations, where persistence of the species depends on re-colonization of local habitats in the event of local extirpations (Bradford et al. 1993, Briggs et al. 2005). As nearby populations are lost, there are reduced opportunities for re-colonization of these sites (Bradford et al. 1993). The current sites inhabited by Sierra Nevada yellow-legged frogs are now largely separated from one another by introduced fish in intervening waterways (Bradford et al. 1993). Bradford (1991) suggested that aspects of Sierra Nevada yellow-legged frog biology have allowed it to persist in the high elevations despite infrequent periodic mass die-offs, including local re-colonization, but noted that re-colonization is now largely precluded in much of the species' range due to introduced fishes forming a barrier. Seemingly natural mass mortality events have been documented to occur in Sierra Nevada yellow-legged frog populations, though they often affect only one cohort of a population (i.e. frogs, metamorphosing tadpoles, or young tadpoles) (Bradford 1983, Bradford 1991).

Stream survey data shows that many stream reaches within the analysis area currently exhibit undesirable habitat characteristics such as unstable stream banks, moderate percentages of fine sediment, and low quantities of coarse woody debris. Stream bank stability and fine sediment can be affected through heavy equipment use associated with mechanical thinning and road building, as proposed under the Sagehen Action Alternatives. Coarse woody debris would be reduced under the Sagehen project resulting in a decrease in future log recruitment, reduced duff layers and a reduction in canopy cover. SMR's (Appendix A) and special RCA protection measures (Appendix D) are in place, and implementation of the project is intended to maintain the function of the RCAs.

As stated previously, MYLF were observed in Sagehen Creek and its tributaries. Since treatment units are in close proximity to perennial stream channels with known populations of MYLF, some cumulative effects could occur. Treatments within RCAs could affect the aquatic indicators of suitable stream miles and suitable riparian habitat acres by affecting stream bank stability, the character of sediment and the character of coarse woody debris. Current conditions for these indicators in some areas fall below desired conditions. There is a level of uncertainty associated with the operation of mechanical equipment within close proximity to stream channels under Alternative 1 and Alternative 3. There is also a slight risk of effects to stream attributes from removal of conifers associated with stream courses under those Alternatives. However, the risk for significant cumulative effects or resource damage is considered low given implementation of the prescribed SMR's (Appendix A). The potential for cumulative effects under Alternative 1 is slightly higher than for Alternative 3 because of the greater number of acres treated within RCA's and frog habitat under Alternative 1 (373 acres) compared with Alternative 3 (241 acres).

GREAT BASIN RAMS-HORN SNAIL

Status: USFS R5 Sensitive

Threats to Great Basin rams-horn snail (GBRHS) include but are not limited to habitat alteration, changes in water flow regime, changes in water quality and loss of hosts for development. Historically, GBRHS has been observed in the Truckee River directly downstream of Lake Tahoe, on the Lake Tahoe Basin Management Unit. Currently, this snail has not been sighted or surveyed for in Tahoe National Forest. Some suitable habitat may exist within or near the project area in Sagehen Creek, its tributaries and associated springs.

As presented above under MYLF and in the general effects section of Chapter 3 FONSI Element #1, there is a slight risk of effects to stream habitat attributes through the use of heavy equipment near stream channels, and the removal of conifer trees that are associated with the streams. It is unlikely that these effects will be detectable in areas of suitable habitat for Great Basin rams-horn snail (GBRHS) due to SMR's (Appendix A) designed to protect RCAs, and the small quantity of units located near low gradient streams which comprise potential habitat.

No cumulative effects unique to GBRHS snails are expected. The general cumulative effects analysis for aquatic wildlife above describes effects to aquatic habitat relevant to this species. The location of the Sagehen Project treatment units outside of perennial stream courses, in conjunction with the management requirements for treatments within RCAs, should prevent the project from adding measurably to cumulative effects to GBRHS.

Plants

Past and Ongoing Cumulative Effects

Management activities have occurred on the eastside of the TNF and privately owned lands for over a century. Historic management activities on TNF lands include: gold mining, gravel mining, hydroelectric development, land clearance, diversions of water for irrigation, land drainage, timber harvest, construction and maintenance of roads and railroads, urbanization, livestock grazing, ground water abstraction, and others (Kondolf et al. 1996). This long history of disturbance to aquatic/riparian plant communities has contributed to the lack of an undisturbed reference for most aquatic/riparian dependent sensitive species. Therefore, it is not possible to quantify how these past management activities have impacted them. Historically, springs, creeks, and rivers were altered by diversion of water; meadows and fens were converted to other types of habitats due to human activity that dried them out; aquatic/riparian areas were repeatedly and heavily grazed by domestic livestock; and numerous roads were built in areas that changed the hydrology of those habitats. These activities and others have cumulatively reduced the amount of aquatic/riparian plant communities within TNF watersheds that would be suitable habitat for: *Botrychium ascendens, B. crenulatum, B. lunaria***,** *B. minganense, B. montanum, Bruchia bolanderi, Epilobium howellii, Fissidens aphelotaxifolius, Helodium blandowii, Hydrothyria venosa, Meesia triquetra,* and *M. uliginosa.* The amount of habitat reduction is unknown. These species are widely occurring within the world, but where they occur their numbers are typically small or the area they cover adds up to be rather small.

There are several ongoing vegetation management projects in adjacent areas that have been planned, partially implemented, implemented or not implemented to the north of Sagehen Basin on the

Sierraville Ranger District. These include Leftover Underburn, Nevada Energy 619, Topaz, Outback, Kangaroo, Billabong, Dinkum, Dingo and Phoenix vegetation management projects. Since many of these projects include management in RCAs, direct impacts were excluded from known fens and sensitive plants sites by flag and avoid mitigations. Indirect or cumulative effects to known occurrences of the riparian dependent sensitive plant species are expected to be mitigated by flag and avoid mitigations as well.

By far, the most frequently occurring disturbances result from the range grazing allotment activities because they are reoccurring every year and livestock have not been excluded from accessing fens in some cases. It is important to note that the Sagehen Allotment was removed from the Tahoe National Forest Allotment grazing permanently in 2006, so that livestock grazing in Sagehen Basin is no longer a contributing factor to the cumulative effects. There are several ongoing range grazing permits that do repeatedly impact riparian vegetation including the special aquatic features on at least a yearly basis. The range allotment grazing permit areas that include fens with and without known sensitive plant occurrences on the Truckee and Sierraville Ranger Districts are: Bear Valley, Beckwourth, Boca, Bickford, English, Independence, Perazzo Meadows, Payen, Smithneck, Kyburz and Pass Creek, Lincoln Valley and Haypress Allotments. On the Truckee Ranger District, the Boca, Kyburz, Sagehen, Sierra Crest and Summit (BKS) Range NEPA was recently approved and includes many guidelines and closures to reduce potential impacts to *Botrychium ascendens, B. crenulatum, B. lunaria, B. minganense, B. montanum, Bruchia bolanderi, Fissidens aphelotaxifolius, Helodium blandowii, Hydrothyria venosa, Meesia triquetra* and *M. uliginosa* or their habitat.

Cumulative Effects in the Foreseeable Future

The Transition and Saddle projects on the Sierraville Ranger District are in the planning stage or appeal process and are expected to minimize impacts to known and potentially occurring riparian species including *Botrychium ascendens, B. crenulatum, Meesia triquetra* and *M. uliginosa* by applying the Best Management Practices, including flag and avoid mitigations that protect the best quality of potential habitat for the riparian dependent species. The Independence Allotment will be updated within the next few years. It is expected that all of these projects would include mitigations to reduce the potential for impacts and monitor for concerns to help manage impacts to TNF sensitive plant species habitat and occurrences.

Summary of Cumulative Effects

Although there are past, ongoing and potential future cumulative impacts to the known sensitive plant occurrences on the Tahoe NF, only a few of these occurrences were found to occur within the units of the Sagehen Project Area. Mitigations to protect the longevity of the fens and the habitat for the known sensitive species were added to the project. The Sagehen Basin remains the refuge for such species on the east side of the Tahoe NF because the most frequent recurring damage to fens across the forest is related to livestock grazing which has been discontinued in the Sagehen Basin. The Sagehen Project remains a very small contributing factor to the potential cumulative effects to these species.

Air Quality

Cumulative Effects of Alternative 1

The VOC, NOx, and PM10 emissions from the action alternatives would contribute to particulate matter loading locally during project implementation. Local effects include cumulative emissions from prescribed burning resulting from past practices, natural surface fuel buildup, and activities on federal, state, and private lands near the Sagehen Project area. The PM2.5 atmospheric concentrations currently do not exceed national standards; however, emissions could exceed California Air Resources Board (CARB) standards if (1) weather conditions predicted by CARB meteorologists do not prevail, or (2) emissions do not disperse as predicted, and/or (3) emissions from other Air Quality Management District's adversely impact air quality in local districts. Forest Service and CARB smoke-dispersal forecasting would be used as part of the burn plan to mitigate effects within the regulatory framework. Potentially VOCs and NOx emissions from prescribed burning could increase ozone concentrations downwind. However, with relatively low loads of fuel burned it is not expected that the resulting ozone concentration would exceed the national or state air quality standards.

The cumulative effects analysis for Air Quality considers ongoing, proposed and reasonably foreseeable future actions. Impacts to air quality from prescribed burning in the project area and adjacent areas during the last five years have been minimal and no Notice of Violation of air quality standards has been issued to the Tahoe National Forest during this period. The action alternatives would not increase the amount of prescribed fire activities in the area above what has been implemented for the last five years. Action alternatives would not impact air quality in the area when combined with ongoing and reasonably foreseeable future actions. However, the action alternatives would have cumulative effects on air quality in the project area and local air basin, but the effects would be managed to be within the regulatory standards of the California Air Resources Board. The dust and emissions from project activities would be mitigated by requiring that Standard Operating Procedures be included with timber sale or service contract packages. Implementation of Alternative 1 would contribute greenhouse gas emissions (CO2); however, the proposed vegetation treatments and prescribed burning would decrease the risk for a high-intensity wildfire and for a resulting greater release of CO2 from the project area. The proposed prescribed fires should prevent potentially much larger risks of a violation of the air quality standard if wildfire occurs in the area of the proposed treatments.

Cumulative Effects of Alternative 2

Under Alternative 2, the project area would be subjected to long-term deposition of surface fuels. Forest fuels would continue to increase with biomass production and would out-produce the decomposition rates in this climate. The long-term chronic effects of wildfires would be higher PM_{10} emissions, mostly due to large areas of exposed soil and ash in the aftermath of a high-intensity wildfire. A high-intensity wildfire under this alternative would also result in greater CO2 emissions compared with Alternative 1 or Alternative 3. Without considering the possibility of future wildfires, the No-action Alternative would have no cumulative effects on particulate matter and visibility.

Cumulative Effects of Alternative 3

Cumulative effects would be similar to those described for Alternative 1.

Recreation

As discussed under FONSI Element 3, The Sagehen Project Area has limited recreation facilities with a small ten unit campground in the northern portion of the project area and a Forest Service maintained road system open to public use. Outside of developed facilities, low intensity dispersed recreation activities occur within the Sagehen Project Area. The Sagehen project would be implemented over a 5 to 10 year period. The implementation of the Sagehen project is likely to overlap with implementation of the ongoing Billymass vegetation management project in the Sagehen Project Area. The Billymass project covers 1,260 acres, 494 of which are within the southerly portion the Sagehen Project Area. Equipment use and hauling of forest products from the Billymass and Sagehen projects may occur concurrently. Minor cumulative impacts to recreational road use may occur because of increased traffic during implementation of the projects. Roads would remain open to public use. The Billymass project is not proximate to Sagehen Creek Campground in the northerly portion of the Sagehen Project Area, so no cumulative effects to the campground and associated dispersed recreation are expected. No cumulative effects would occur under Alternative 2 (No Action); minor cumulative effects to recreation resources may occur under Alternative 1 and Alternative 3 with the risk of effects under Alternative 1 being slightly higher because of the larger number of acres treated.

Economics

The Tahoe National Forest has, and will continue to, plan and implement vegetation management projects into the future. Harvest volumes on the Tahoe National Forest between 2001 and 2010 have ranged from 10 to 50 million board feet (mmbf), with a ten year average of 33 mmbf per year. The Truckee Ranger District averaged 3 mmbf per year over a recent five year period (2007 – 2011). Maintaining the infrastructure for logging and wood product processing is essential in allowing the Forest Service to meet multiple forest resource objectives. Vegetation management projects such as Sagehen are important to sustain jobs in the local economies of Nevada and Sierra Counties. During the current period of low economic growth and high unemployment, a project like Sagehen gains importance. Alternative 1 and Alternative 3 would both create jobs and help maintain the logging and wood processing infrastructure which has seen dramatic decline in recent decades. As previously discussed Alternative is 1 projected to create well over twice as many jobs as Alternative 3 (380 to 123) over the next five years. Alternative 2 would not create jobs associated with logging and wood processing and would not support the local economy.

Cultural Resources

No cumulative effects to cultural resources are anticipated within the Sagehen Project Area as a result of project alternatives. For detailed discussion of potential effects to cultural and historic resources see FONSI Element 8, below, and also FONSI Element 3.

<u>Element 8.</u> The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources (40 CFR 1508.27 (b)(8)).

Ethnographically the Truckee/Sierra Valley Region was used by the Northern Washoe. The Washoe Tribe of Nevada and California is a Federally recognized tribe and was consulted throughout the collaboration, planning, and public input phases of this project. There are no known traditional cultural properties or places of religious or cultural importance in the Sagehen Basin.

A record search, inventory, and cultural resource report have been completed for the proposed Sagehen Project under provisions of the programmatic agreement (PA) with the Advisory Council on Historic Preservation and the California State Historic Preservation Office (SHPO), in compliance with Section 106 of the National Historic Preservation Act. The file number for the Sagehen Project cultural resource report is R2005051700106 (Smith, 2012). The report documents the results of the archaeological inventory and the historic archaeological sites in the Area of Potential Effects (APE). The culture resources report is not available for public release because it contains sensitive information concerning the location of cultural resources.

Assessment of cultural resources within the Sagehen Project Area identified ten historic sites near treatment units. Three segments of railroad grade eligible for the National Register of Historic Places were also identified within the project area. Implementation of any of the project alternatives would not affect cultural resources eligible for listing in the National Register of Historic Places, nor would it cause loss or destruction of any significant cultural or historical resources. Potential adverse effects on cultural resources would be avoided by the location of project activities away from and by avoiding cultural resources, following standard practices that have been developed to implement the applicable provisions of the National Historic Preservation Act. If any previously unknown cultural resources are discovered during project implementation, operations would cease in the area of new discovery until analysis is conducted and protections measures are implemented as needed consistent with the PA. See Appendix A, SMRs 28, 29 and 30 for more information on how impacts to cultural resources will be avoided.

The Washoe Tribe of Nevada and California was consulted for comments on the proposed action in November of 2011 and on the preliminary EA during the 30-day comment period in March 2013. No comments were received from the tribe related to the Sagehen Project.

Element 9. The degree to which the action may adversely affect an endangered or threatened species or its critical habitat (40 CFR 1508.27 (b)(9)).

The Fish and Wildlife Service is contacted every 90 days to obtain a current list of threatened, endangered, proposed, and candidate species that may be present on the Tahoe National Forest. This list is maintained at 50 CFR 17.11. The most recent list was updated September 18, 2011 and reported November 8, 2012, and can be accessed at the following location: http://www.fws.gov/sacramento/es_species/Lists/es_species_lists_NF-action-page.cfm. The following special status species either are known to occur within or have habitat within the analysis areas for the Sagehen Project: Sierra Nevada yellow-legged frog (USFWS Candidate), California Wolverine (USFWS Proposed) and Lahontan cutthroat trout (USFWS Threatened). Biological evaluations have been completed to document analysis of the potential effects of the proposed action on these species and their habitats. The project biological evaluations are incorporated into this EA by reference and are available upon request. Consultation with the United States Fish and Wildlife Service (USFWS) is not needed for this project. No Federally listed threatened, endangered or candidate wildlife species or critical habitat would be affected by the proposed action or alternatives. Species specific rationale for these findings is below.

California Wolverine

Status: R5 Sensitive, USFWS Proposed
On February 4, 2013, The U.S. Fish and Wildlife Service published a proposed rule to list the distinct population segment of the North American wolverine occurring in the contiguous United States, as a threatened species under the Endangered Species Act (USDI Fish and Wildlife Service 2013; [FWS–R6–ES–2012–0107: 4500030113]. FWS also proposes a special rule under section 4(d) of the Act to apply the specific prohibitions of the Act necessary to protect the wolverine. The FWS has determined that habitat loss due to increasing temperatures and reduced late spring snowpack due to climate change is likely to have a significant negative population-level impact on wolverine populations in the contiguous United States. In the future, wolverine habitat is likely to be reduced to the point that the wolverine in the contiguous United States is in danger of extinction.

Implementation of Alternatives 1 and 3 may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the California wolverine within the planning area of Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of the California wolverine as discussed previously in this evaluation, and professional judgment. The USDI Fish and Wildlife Service, in their proposed rule to list the wolverine as threatened, state that while land management activities, such as timber harvest, wildland firefighting, prescribed fire, and silvicultural practices can modify wolverine habitat, the wolverine is a habitat generalist and appears to be little affected by changes to the vegetative characteristics. Most wolverines occur at high elevations with rugged terrain that is not conducive to intensive forest management. The

Service further states that habitat modifications resulting from the types of treatments proposed for the Sagehen Project would not significantly affect the conservation of the species. These findings are based on the effects analysis under FONSI Elements 1 and 7 earlier in this chapter, and the Terrestrial Wildlife BE prepared for the project.

Lahontan Cutthroat Trout

Status: USFWS Threatened

The Lahontan cutthroat trout (LCT) was listed by the USFWS as an endangered species in 1970 (USDI Fish and Wildlife Service 1970; 35 FR 13520). The listing was reclassified to threatened status in 1975 to facilitate recovery and management efforts and to authorize regulated angling (USDI Fish and Wildlife Service 1975; 40 FR 29864). Currently, no Critical Habitat has been designated for the Lahontan cutthroat trout (USDI Fish and Wildlife Service 1995).

Direct species effects would not occur since the species is absent from the analysis area and project activities, including road building, will not occur near occupied LCT habitat. Implementation of Alternative 1 or Alternative 3 will not affect the Lahontan cutthroat trout, *Oncorhynchus clarki henshawi* or its designated critical habitat. These findings are based on the effects analysis under FONSI Elements 1 and 7 earlier in this chapter, and the Aquatics BE prepared for the project.

Sierra Nevada Yellow-Legged Frog (Sierra Nevada Dps)

Status: R5 Sensitive, USFWS Candidate

Within the Tahoe National Forest, Sierra Nevada yellow-legged frog (MYLF) is listed as a USFS R5 Sensitive and as a USFWS Candidate species, being part of the Sierra Nevada Distinct Population Segment (DPS) as defined by the USFWS. On January 10, 2003 (and as revised on June 25, 2007) the USFWS found that listing of the Sierra Nevada DPS as threatened or endangered was warranted but precluded by higher priority actions and the species was listed as a Candidate (USDI Fish and Wildlife Service 2003; 68 FR 2283, and revised by USDI Fish and Wildlife Service 2007; 72 FR 34657)

Direct effects to individual frogs could occur from implementation of the Sagehen Project. There is the potential for frogs to be harmed if they are present during the time activities are occurring. Under Alternative 1, there are more activities occurring in RCAs (373 acres) than under Alternative 3 (241 acres), increasing the potential for interaction with frogs. Provided that protection measures prescribed in SMR 31 (Appendix B), such as pre-activity surveys and limited operating periods, are properly implemented, direct, indirect and cumulative effects from the Sagehen Project treatments should not significantly alter MYLF distribution or population size. Implementation of Alternative 1 or Alternative 3 may affect individuals of MYLF, *Rana sierrae,* but is not likely to result in a trend toward Federal listing or loss of viability for this species within the planning area of the Tahoe National Forest. In the absence of a range wide viability assessment, this viability determination is based on local knowledge of this species as discussed previously in this evaluation, and professional judgment. These findings are based on the effects analysis under FONSI Elements 1 and 7 earlier in this chapter, and the Aquatics BE prepared for the project.

<u>Element 10.</u> Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protections of the environment (40 CFR 1508.27 (b)(10)).

Implementation of the proposed action would not threaten a violation of Federal, State, or local law. The proposed action complies with the National Forest Management Act (NFMA), Endangered Species Act (ESA), Clean Water Act, and the National Historic Preservation Act (NHPA). The proposed action is fully consistent with the Tahoe National Forest Land and Resource Management Plan (Forest Plan, 1990) as amended by the Sierra Nevada Forest Plan Amendment (2004) and the Sierra Nevada Forests Management Indicator Species Amendment (2007).

National Forest Management Act

The Forest Plan for the Tahoe National Forest provides management direction for the NFS lands located within the Sagehen Project Area. The Forest Plan was developed according to the stipulations of the National Forest Management Act of 1976. Alternative 1, the proposed action, includes a project-level, non-significant Forest Plan amendment for vegetation treatments within one of the five northern goshawk PAC's within the project area in order to be consistent with the Forest Plan. Alternative 3 is consistent with the Forest Plan and would not require a plan amendment. The primary Forest Plan management goals and objectives that guided development of the Sagehen Project alternatives are discussed below.

Protecting old forest ecosystems and associated species. (SNFPA ROD, 2004): The old forest conservation goals and strategies in the Forest Plan guide management to increase the frequency of large trees, and increase the structural diversity of vegetation, while protecting, increasing and perpetuating desired conditions of old forest ecosystems and conserving species associated with these systems. Enhancing old forest habitat and conserving associated species is a primary objective of Alternative 1. Under Alternative 3, the limited extent and placement of treatment units along with implementation of various SMR's (Appendix A) would protect existing old forest habitat. Under Alternative 2, no action is proposed and existing old forest conditions would be maintained.

Providing the wildlife habitat and other ecological conditions necessary to maintain well-distributed viable populations of Management Indicator Species (MIS) in the project area and bioregional scale, and maintain diversity of plants and animals (SNF MIS ROD, 2007): The Terrestrial and Aquatic Wildlife MIS Reports determined that Project-Level habitat impacts on any MIS would not be significant and would not contribute to bioregional-scale trends for any MIS. Summaries for each habitat-population trend are in FONSI Elements 1 and 7, and more details are presented in the Sagehen Project MIS Reports, which are incorporated by reference.

Protecting aquatic, riparian and meadow ecosystems and associated species. (SNFPA ROD, 2004): Aquatic, riparian and meadow ecosystems and associated species are protected through project design features in the action alternatives and implementation of a variety of SMR's (Appendix A). Hydrology,

soils, aquatic and botanical evaluations were prepared for this EA and no significant effects to aquatic, riparian and meadow ecosystems or associated species were identified. Potential direct and indirect effects to these resources are discussed under FONSI Element 1 and in the respective resource specialist reports incorporated by reference. A Riparian Conservation Objective Analysis was performed for the project and is included as Appendix D.

Reducing the threat to communities and wildlife habitat from large, severe wildfires. (SNFPA ROD, 2004): A primary goal driving development of the Sagehen Project has been reducing the threat to wildlife habitat from large, severe wildfires. The vegetation treatment prescriptions under Alternative 1 would modify landscape scale fire behavior to the benefit of the Sagehen Field Station and wildlife habitat and meet this goal to a fuller extent than under Alternative 3, which focuses on localized fuels treatments to primarily protect the Sagehen Field Station. Under Alternative 2, no action is proposed and existing trends would continue.

Non-Significant Forest Plan Amendment

Under the proposed action (Alternative 1), mechanical treatments would be conducted within a northern goshawk protected activity center (PAC) to implement the following silvicultural prescriptions: variable thin, legacy tree treatment, suppressed cut, early seral opening, and dense cover area. In addition, decadent feature enhancement, and underburning are proposed treatments in this PAC under Alternative 1.

The affected PAC (the NE Sagehen Goshawk PAC (D57T23)) falls entirely within a wildland urban intermix (WUI) threat zone. *Sierra Nevada Forest Plan Amendment Record of Decision* (SNFPA ROD, 2004) Standard and Guideline #72 states: "In PACs located in WUI threat zones, mechanical treatments are allowed where prescribed fire is not feasible and where avoiding PACs would significantly compromise the overall effectiveness of the landscape fire and fuels strategy. Mechanical treatments should be designed to maintain habitat structure and function of the PAC." (2004 SNFPA ROD, pg. 60). In addition, Forest Plan direction for mechanical thinning treatments within PACs states, "…where treatment is necessary, remove only material needed to meet project fuels objectives. Focus on removal of surface and ladder fuels." (2004 SNFPA ROD, Standard and Guideline #7, pg. 51).

Under the proposed action, the portion of the NE Sagehen PAC encompassed within treatment unit #38 would be mechanically treated as part of the Sagehen Project's landscape fire and fuels strategy. (Refer to the Fire/Fuels Report Addendum (April 29, 2013) for the analysis of treating Unit 38 as part of the Project's landscape fire and fuels strategy.) However, a Forest Plan amendment is needed because the mechanical treatments proposed in this PAC would meet objectives beyond simply reducing hazardous fuels as part of a landscape fire and fuels strategy and would remove material beyond that needed to solely meet fuels reduction objectives. The proposed treatments are based on principles from GTR-220 (North et al. 2009), with specific objectives to not only reduce hazardous fuels but also improve wildlife habitat for mature forest associated species, such as the goshawk. The treatments are aimed at promoting forest resiliency and patch-scale heterogeneity to meet marten habitat enhancement and

stand-level ecological restoration objectives. Specific proposed treatments include variable thinning and legacy tree treatments to promote the development and growth of larger trees; early seral openings and dense cover areas to promote forest heterogeneity; and decadent feature enhancement to increase snag densities.

Mechanical thinning treatments within this PAC would meet the forest-wide standards for mechanical thinning treatments (SNFPA ROD, pp. 50 through 51), consistent with Standard and Guideline #73 direction that treatments in PACs (outside a 500-foot radius around the activity center) meet the forest-wide standards and guidelines for mechanical thinning (SNFPA ROD, pg. 60).

The amendment would apply to the portion of forest-wide Standard and Guideline #7 that requires mechanical treatments in PACs remove only material needed to meet project fuels objectives. The proposed amendment would allow for mechanical treatments aimed at not only reducing hazardous fuels but also promoting forest resiliency and patch-scale heterogeneity in NE Sagehen Goshawk PAC (D57T23) under the Sagehen Project. The National Forest Management Act (NFMA) requires that proposed forest plan amendments be evaluated for whether they would constitute a significant change in the long-term goods, outputs, and services projected for the national forest. The following criteria are used to determine the significance of forest plan amendments (Forest Service Manual 1926.51-52).

1. Actions that do not significantly alter the multiple-use goals and objectives for the long-term land and resource management. The amendment would be consistent with the Forest Plan goals to "protect, increase, and perpetuate desired conditions of old forest ecosystems and conserve species associated with these ecosystems while meeting people's needs for commodities and outdoor recreation activities" (SNFPA ROD, pg. 31). Including objectives for protecting and enhancing marten habitat and promoting stand-level ecological restoration for mechanical treatments within the NE Sagehen goshawk PAC for this single project would not significantly alter, and would be consistent with, Forest Plan goals and objectives to provide habitat for old forest dependent species in the long-term (SNFPA ROD, pg. 6).

Mechanical treatments to be conducted in the NE Sagehen Goshawk PAC include variable thinning, legacy tree treatment, suppressed cut, decadent feature enhancement, and creation of early seral openings. Other treatments in this PAC include retention of dense cover areas and underburning. Under Alternative 1, approximately 132 acres of nesting habitat and 7 acres of foraging habitat would be mechanically treated. Out of 132 acres of suitable nesting habitat, 93 acres would change from CWHR 4D to 4M post-treatment, and 39 acres of CWHR 4M would remain 4M post-treatment. Mechanical treatments would change canopy cover in the portion of Unit 38 that lies within the PAC (160 acres) from 71 to 50 percent, resulting in a short-term reduction in habitat quality. However, all treated habitat would remain suitable goshawk habitat following treatments.

Understory vegetation would become more open as a result of the thinning treatments and underburning, which would provide more open forest conditions preferred for hunting by goshawks. Legacy tree treatments would promote the growth of larger trees, which would provide more nesting structures. Decadent feature enhancements would enhance prey habitat and goshawk roosting/resting habitat by increasing the abundance and distribution of snags. Overall, when considered together, all

the various treatments including retention of dense cover areas and creation of early seral openings would provide increased horizontal and vertical diversity that would be beneficial to goshawks for nesting and foraging in the long term.

2. Adjustments of management area boundaries or management prescriptions resulting from further on-site analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long-term land and resource management. This amendment would not change management area boundaries or management prescriptions. The amendment would not trigger changes in the classification and management of northern goshawk PACs on the Tahoe National Forest. Ultimately, this amendment would support achievement of multiple-use goals for reducing hazardous fuels, protecting and enhancing habitat for the marten, and providing for stand-level ecological restoration while maintaining and improving the habitat structure and function of the treated goshawk PAC.

3. Minor changes in standards and guidelines. The amendment would make a one-time, minor change in the forest-wide standard and guideline for mechanical thinning treatments, specifically in PACs (SNFPA ROD, Standard and Guideline #7, pg. 51). (While this standard and guideline specifically refers to California spotted owl PACs, other standards and guidelines for California spotted owl and northern goshawk PACs (SNFPA ROD, pp. 59 through 61) indicate that this standard and guideline also refers to treatments in northern goshawk PACs.) The proposed amendment accommodates objectives aimed at protecting and enhancing habitat for the marten (and other old forest associated species, including the goshawk) and providing ecological restoration at the stand level. As described under Item #1 above, the proposed treatments in the NE Sagehen PAC under the Sagehen Project would provide increased horizontal and vertical diversity that would be beneficial to goshawks for nesting and foraging in the long term.

4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription. With the exception of a minor change to SNFPA ROD forest-wide standard and guideline #7 to allow treatments in a PAC under the Sagehen Project to meet project objectives aimed at benefitting long-term habitat conditions for the marten (and other old forest species such as the goshawk), the proposed action would be consistent with all existing Forest Plan standards and guidelines for PACs, including avoiding mechanical treatments in the Sagehen Project Area's four other goshawk PACs and applying limited operating periods. This approach of focused treatment in one PAC as part of the landscape-level fuels strategy and to meet marten habitat protection and improvement objectives and avoiding treatments in other PACs would contribute to achieving the Forest Plan's overall goal of "sustaining viable populations of at-risk species associated with old forest ecosystems well-distributed across Sierra Nevada national forests" (SNFPA ROD, pg. 31).

5. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (36 CFR 219.10(e)). This amendment would not alter the long-term relationships between the levels of goods and services projected by the 1990 *Tahoe National Forest*

Land and Resource Management Plan as amended by the *Sierra Nevada Forest Plan Amendment Record of Decision* (2004) and the *Sierra Nevada Forests Management Indicator Species Amendment* (2007). This amendment would constitute a minor change to a portion of a standard and guideline for one goshawk PAC (the NE Sagehen PAC) under the Sagehen Project only. As such, this amendment would not alter the long-term relationship between levels of multiple-use goods and services originally projected in the Forest Plan.

6. Changes that may have an important effect on the entire forest plan or affect land and resources throughout a large portion of the planning area during the planning period. This amendment would affect a small portion (approximately 0.8 percent or 1 out of 128 PACs) of the Tahoe National Forest's existing goshawk PACs. In addition, implementation of the Forest Plan's standards and guidelines for minimizing disturbance to breeding goshawks and minimizing impacts to goshawk habitat in PACs under the Sagehen Project would have an overall beneficial effect of minimizing disturbance to goshawks and their habitat in the Sagehen Basin. This amendment would not change land allocations or management direction for other elements of the Forest Plan. It would reduce the quality of suitable goshawk habitat in a small portion (approximately 0.5 percent or 139 out of 27,492 acres) of the overall acreage in goshawk PACs across the Tahoe National Forest. This reduction in habitat quality would be a short-term effect. The proposed amendment would not affect the entire Forest Plan, nor would it affect land and resources throughout a large portion of the planning area during the planning period.

Vegetation Management Requirements

The Sagehen Project meets the National Forest Management Act (NFMA) requirements detailed in FSM 1921.12a – Timber Management Requirements. A responsible official may authorize project and activity decisions on National Forest System lands to harvest timber only where:

A. Soil, slope, or other watershed conditions will not be irreversibly damaged.
Action Alternatives 1 and 3 include resource protection measures and SMRs, including BMPs, contract provisions, and other project specific design features to protect riparian areas, minimize soil erosion and compaction. Multiple watershed restoration actions would improve the existing condition of the watersheds at the project level. Road repair and maintenance has been designed to improve watershed conditions, and temporary roads would be closed and decommissioned after use.

B. There is assurance that the lands can be adequately restocked within five years after final regeneration harvest (FSM 1921.12g). The Sagehen Project involves thinning of forest stands to more desirable tree densities. No re-stocking would be required for any of the alternatives.

C. Streams, streambanks, shorelines, lakes, wetlands, and other bodies of water are protected from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment where harvests are likely to seriously and adversely affect water conditions or fish habitat. Timber harvesting activities under the Sagehen Project alternatives are not expected to seriously and adversely affect water conditions or fish habitat. Detailed analyses were conducted concerning project effects on streams, wetlands and other bodies of water within the treatment units and surrounding areas; these

analyses can be found in Chapter 3, FONSI Element 1 under the Hydrology, Soils, and Aquatic Wildlife headings. Additional information on how these features are protected can be found in Appendix A (SMR's) and Appendix D (RCO Analysis).

D. The harvesting system to be used is not selected primarily because it will give the greatest dollar return or the greatest unit output of timber.

The harvesting systems proposed under the Sagehen Project Action Alternatives were selected to meet multiple resource objectives, including enhancement of old forest conditions. Although the project would contribute to the local economy through implementation of cost effective treatments, harvesting systems were not selected primarily to give the greatest dollar return or the greatest unit output of timber. Protection of resources was given careful consideration in selection of project harvesting systems.

E. A Responsible Official may authorize projects and activities on NFS lands using cutting methods such as clearcutting, seed tree cutting, shelterwood cutting, and other cuts designed to regenerate an even-aged stand of timber, only where certain conditions defined in 16 U.S.C. 1604 (g)(3)(F) are met.

1. For clearcutting, it is the optimum method; or where seed tree, shelterwood, and other cuts are determined to be appropriate to meeting the objectives and requirements of the relevant plan (16 U.S.C. 1604 (g)(3)(F)(i)). No clearcutting, seed tree or shelterwood cuts are proposed by the Sagehen Project (Alternatives 1 or 3), since even-aged timber management is not an objective of this project.

2. The interdisciplinary review has been completed and the potential environmental, biological, aesthetic, engineering, and economic impacts have been assessed on each advertised sale area and the cutting methods are consistent with the multiple use of the general area (16 U.S.C. 1604 (g)(3)(F)(ii)). The ID Team has reviewed the Sagehen Project, as documented in supporting analyses, and has assessed the environmental impacts of the proposal. Standard road maintenance would be needed and specified in the contract. An economic analysis of the project indicates that the project would contribute to jobs and wages that would contribute to the community stability of the local rural economy. The proposed silvicultural treatments would be consistent with the Forest Plan standards and guides.

3. Cut blocks, patches, or strips are shaped and blended to the extent practicable with the natural terrain (16 U.S.C. 1604 (g)(3)(F)(iii)). Sagehen Project vegetation treatments thin overstocked forest stands and are designed to be naturally appearing and blend with the natural terrain. See Chapter 2 and Appendix B (Maps) in regard to design and layout of treatment units and prescriptions.

4. Cuts are carried out according to the maximum size limits for areas to be cut in one even-aged regeneration harvest operation (16 U.S.C. 1604 (g)(3)(F)(iv)). No even-aged regeneration harvest is proposed under the alternatives, so this even-aged specific size limit direction does not apply to the Sagehen Project.

5. Timber cuts are carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation, esthetic resources, cultural and historic resources, and the regeneration of timber resources. In addition to resource sensitive project design features, the ID Team has developed Standard Management Requirements (SMR's), including BMPs which would be incorporated into project Timber Sale or Service Contracts to protect the environment and assure that any potential impacts are minimized (See EA *Appendix A* Sagehen Project SMRs). The potential resource risks below were also considered.

- *Weed Risk Assessment:* A weed risk assessment was conducted for the Sagehen Project, hereby incorporated by reference and available upon request. "A", "B", and "C" rated invasive plants were considered in the weed risk analysis for the Sagehen Project. The ratings reflect the statewide importance of the pest and the likelihood that eradication or control efforts would be successful, with the "A" rating deemed to have the best likelihood of successful control efforts and importance and the rating "C" deemed to have the least likelihood of successful control efforts and importance. There is a low risk of spreading the "A" rated invasive plants into the Sagehen Project Area if mitigations are followed to prevent musk thistle, which is known to occur in two old Phoenix Project landings, from spreading. A noxious weed symbol would be placed on the Timber Administration map on the southeastern corner of the project area in the Phoenix Project landings that have been infested. Another site that would be marked for avoidance is where "A" rated musk thistle and "B" rated tall whitetop has also been found near the entrance to Bickford's Ranch, so that this site can be avoided and follow up monitoring for musk thistle and tall whitetop would also occur. Mitigations to require clean equipment that is free from dirt and weed seeds would be enforced. "C" rated weeds bull thistle, wooly mullein and cheatgrass are so widespread that they are expected to spread. Usually bull thistle and wooly mullein subside as the native vegetation recovers in the project area. Cheatgrass would most likely be present on drier sites such as south-facing hill slopes and would likely never disappear. Mitigation measures to minimize the risk for spreading invasive plants are detailed in SMR's #26 and 27 (Appendix A), and include the measures described above.

- *Tree Disease Risk:* The Action Alternatives would produce an unnaturally large number of freshly cut stumps, which are widely known to increase the potential avenue of spread of Annosus root disease via interconnected roots. Application of borax to cut conifer stumps would create a barrier that minimizes the risk potential for spores of the fungus *Heterobasidion annosum* to colonize freshly cut stumps.

- *Borax Risk Evaluation*: The effects of borax (Sporax™) application on forest resources, workers, and forest users has been assessed in Chapter 3 under FONSI Element 1 and in the Sagehen Project Borax Risk Assessment hereby incorporated by reference. Available studies on borax indicate that it is relatively benign to humans and the environment. Reports of adverse impacts from borax and related borate compounds occur only when exposures are much greater than would be expected under the Sagehen Project alternatives. Proposed

borax use rates and hand application to the surface of recently cut stumps are not expected to result in exposures that would cause adverse effects to humans or the environment. Project design features and management requirements (SMR 13, Appendix A) provide additional assurance that proposed application of borax to cut stumps would have no adverse direct, indirect or cumulative impacts to human health and safety and the environment.

6. Stands of trees are harvested according to requirements for culmination of mean annual increment of growth (16 U.S.C. 1604 (m); FSM 1921.12f; FSH 1909.12, ch. 60).
The culmination of mean annual increment requirements apply only to even-aged management at the time of regeneration harvest. None of the Sagehen Project Action alternatives propose regeneration harvest.

Sensitive Species

The Forest Service defines sensitive species as those plant and animal species identified by a Regional Forester for which population viability is a concern. The Regional Forester of the Pacific Southwest Region (Region 5) maintains a list of sensitive species for the Region which applies to the Tahoe National Forest; effects to these species were considered in the analysis of the Sagehen Project. The directives for management of sensitive species include ensuring that species do not become threatened or endangered because of Forest Service actions, and maintaining viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands (Forest Service Manual 2670.22). Potential direct, indirect, and cumulative effects of the proposed action on Forest Service sensitive species are analyzed previously in this chapter under FONSI Elements 1 and 7, and described in detail in the Sagehen Project Terrestrial Wildlife, Aquatic Wildlife, and Plants Biological Evaluations / Assessments, which have been incorporated by reference into this EA.

Biological Assessments for sensitive terrestrial wildlife and aquatic wildlife species found that implementation of Alternative 1 or Alternative 3 could affect the following sensitive species: Bald eagle, California spotted owl, Great grey owl, Northern goshawk, Willow Flycatcher, Pacific marten, and Sierra Nevada yellow-legged frog; however, effects to these species would not likely result in a trend toward federal listing nor loss of viability for these species within the planning area of the Tahoe National Forest. The following sensitive species and their habitats would not be affected by Alternative 1 or Alternative 3 because no suitable habitat is present or the project area is outside of the distributional range of the species: Pacific Fisher, Sierra Nevada red fox, Western red bat, Townsend's big-eared bat, Pallid bat, Foothill yellow-legged frog, Lahontan Lake tui chub, Hardhead, Northwestern pond turtle and California floater mussel. Greater sandhill crane would not be affected by the project alternatives because the nearest breeding population is outside of the effects analysis area. Great Basin ram horn snail has habitat within the project area but would not likely be affected by project activities because no proposed treatments under the alternatives would occur directly within perennial water bodies. Potential direct, indirect, and cumulative effects of the proposed action on these species are discussed in more detail previously in this chapter under FONSI Elements 1 and 7, and described thoroughly in the

Sagehen Project Wildlife and Aquatic Biological Evaluations / Assessments, which have been incorporated by reference into this EA.

The Biological Assessment for Forest Service sensitive plant species found that implementation of Alternative 1 or Alternative 3 could adversely affect a few individuals of those species that are assumed to be present or are known to be present within or near the treatment units: *Botrychium lunaria* (common moonwart)*, B. minganense* (Mingan moonwart)*, B. montanum* (moonwart)*, Bruchia bolanderi* (Bolander's candle moss)*, and Helodium blandowii* (Blandow's bog moss)*, Botrychium ascendens* (moonwart)*, B. crenulatum* (moonwart)*, Ivesia sericoleuca* (Plumas Ivesia), *Meesia triquetra* (moss) and *M. uliginosa* (moss). The actions proposed under the alternatives could impact a few individuals of these species, but proposed activities would not be likely to cause a trend to federal listing or a loss of viability because about 80 percent of habitat in the project area occurs outside proposed treatment units and impacts to habitat would be minimized by the use of flag and avoid mitigations and Best Management Practices detailed in the SMR's for sensitive plants (Appendix A). The implementation of these mitigations would help protect the best potential habitat that exists in special aquatic features like fens, springs, seeps, stream banks and stream courses within the Riparian Conservation Areas where these plants could be present. Since fungi species are not included under the ESA, no determination pertaining to their listing is relevant; however, effects to potential habitat for the fungi species *Cudonia monticola* (large cudonia) were analyzed. The analysis suggests that under both Alternative 1 and Alterntive 3, there exists a sufficient amount of acreage that contains undisturbed thick duff or moss layers and rotting wood with high humidity where *Cudonia monticola* can exist and spread. The following species would not be affected by implementation of Sagehen Project Alternative 1 or Alternative 3, because none of these plants or their suitable habitat were found present or within close proximity to the project area: *Boechera rigidissima* var. *demota, Astragalus webberi, Epilobium howellii, Erigeron miser, Eriogonum umbellatum* var. *torreyanum, Fissidens aphelotaxifolius, Hydrothyria venosa, Ivesia aperta* var. *aperta*, *I. aperta* var. *canina, I. webberi, Lewisia kelloggii spp. hutchisonii, L. k. spp. kelloggii, L. longipetala, Pyrrocoma lucida* and *Tauschia howellii.*

Alternative 2 (No Action) would have no direct effects on sensitve terrestrial wildlife, aquatic wildlife and plant species beyond existing trends. Indirect adverse effects from high fuel loading to any and all of the sensitive species under Alterntaive 2 could occur related to a high intensity wildfire burning in the Sagehen Basin and associated fire suppression activities. Occupation of the area by invasive plants after high intensity wildfires would also likely have adverse effects on sensitive habitat and plant species.

Migratory Birds

In late 2008, a *Memorandum of Understanding between the USDA Forest Service and the USDI Fish and Wildlife Service to Promote the Conservation of Migratory Birds* was signed. The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service (USFWS) as well as other federal, state, tribal and local governments. Within the National Forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed

when planning for land management activities. A Migratory Landbird Conservation Report, hereby incorporated by reference and available upon request, was prepared for the Sagehen Project (February, 2013). The findings of the report are described below.

Alternative 1 of the Sagehen Project would not adversely affect migratory landbird species or their associated habitats. Potential effects to migratory species would be minimized through project design, integrated design features and adherence to LRMP Standards and Guidelines.

Alternative 3 of the Sagehen Project would have similar design features as Alternative 1 (such as snag and log retention), however would not create snags, nor would it substantially increase overall heterogeneity. It would treat fewer acres with only a focus on fuels reduction. There would be less direct project impacts on the landscape compared to Alternative 1, simply with fewer acres treated, however treatments would be less likely to meet the multiple project objectives. Overall, Alternative 3 would not likely adversely affect migratory landbird species or their associated habitats, but would do less to restore habitat conditions for many species.

Under the No Action Alternative, no management actions would take place. Treatments that would increase forest resiliency and microsite and stand-level heterogeneity would not be implemented. Existing conditions and processes in the analysis area such as stand susceptibility to insect, disease, and drought induced mortality; tree mortality rates at projected unsustainable levels; and current potential for uncharacteristically large wildfire effects to forest resources within the project area would continue to persist or develop along current trajectories.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 allows for designation of selected rivers in the United States to protect outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Rivers or sections of rivers, so designated are preserved in their free-flowing condition and are not dammed or otherwise impeded. The *Eight Eastside Rivers: Wild and Scenic River Study Report, Record of Decision* (February, 1999) provides interim management standards for Sagehen Creek as a Scenic River until such time as Congress takes action and formally designates the river or chooses not to do so. As classified under the Act, Scenic Rivers are "those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads."

According to the February, 1999 Record of Decision, "Sagehen Creek hosts numerous outstandingly remarkable values that are best identified as ecosystem values." Outstandingly remarkable values for the creek include: hydrology, geology, wildlife, fisheries and plants. Several of these values are associated with the unique wetlands known as fens in the Sagehen Basin. In addition, historic remains of steam engine logging infrastructure are regionally significant and outstandingly remarkable.

Appendix A of the *Eight Eastside Rivers: Wild and Scenic River Study Report, FEIS* (July, 1998) provides management guidelines for eligible Scenic Rivers on the Tahoe National Forest, including Sagehen Creek. According to this management direction, a wide range of silvicultural practices could be allowed within

the creek's ½ mile wide eligible Scenic corridor provided that when such practices are carried out there are no substantial adverse effects on the river and its immediate environment. Project vegetation treatments have been designed and located to avoid impacts to cultural resources within the Scenic River corridor and the remainder of the project area. The silvicultural prescriptions proposed under Alternatives 1 and 3 avoid substantial adverse impacts to Sagehen Creek, and RCA's in general, through the use of Tractor Keep Out areas to protect stream banks and the use of manual rather than mechanical treatment methods in many locations. Please refer to the RCO analysis (Appendix D) and SMR's (Appendix A) for a detailed accounting of all the protections afforded Riparian Conservation Areas, including Sagehen Creek, under the action alternatives. Under Alternative 1, the treatment prescriptions would enhance the ecology of the Scenic River corridor by promoting heterogeneous and natural appearing forest stand structure. Under all the Sagehen Project alternatives the outstandingly remarkable values of the Sagehen Creek eligible Scenic River would be protected.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 requires that: The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking. Preparation of the Sagehen Project Archaeological Report under provisions of the Programmatic Agreement with the Advisory Council on Historic Preservation and the California State Historic Preservation Office (SHPO) satisfies requirements of Section 106 of the National Historic Preservation Act. No significant effect to historic or prehistoric cultural resources is anticipated under any project alternatives. Further detail on the cultural resources analysis can be found under FONSI Element 8.

Clean Water Act

This project complies with the Clean Water Act through use of "Best Management Practices" designed to minimize or prevent the discharge of both point and non-point source pollutants from Forest roads, developments and activities. Under the Clean Water Act regulations, the Forest Service is required to obtain permits from the Lahontan Regional Water Quality Control Board (LRWQCB). The Forest Service is working with the LRWQCB to secure the appropriate permit(s) for this project as discussed below.

The proposed project has incorporated management requirements to meet the water quality objectives for beneficial use as established by the Lahontan Regional Water Quality Control Board in the Water Quality Control Plan for the Lahontan Regions, and the Federal Clean Water Act (see SMR's 22, 23 and 24, Appendix A). It would comply with the Water Quality Objectives and Prohibitions contained in the Basin Plan and would meet the requirements for obtaining a Timber Harvest Waiver. It would be eligible for the applicable waiver because:

1) This EA, associated appendices and documents incorporated by reference are the product of an interdisciplinary team's (IDT) review of the project.
2) The IDT conducted a Cumulative Watershed Effects (CWE) assessment (incorporated by reference and summarized in FONSI element #7).

3) The IDT will develop a Water Quality Monitoring Plan during the waiver application process to specify the actions that would be taken during and after implementation of the proposed actions to ensure that water quality objectives are met.

4) This EA is consistent with NEPA requirements for public comment.

5) As discussed below, beneficial uses would be maintained and would achieve the highest water quality consistent with maximum benefit to the people of the State.

   The water quality objectives for beneficial uses that could potentially be affected by the Sagehen Project include sediment, temperature and turbidity, also to a lesser degree pesticides (Boron) and oil and grease. Detailed discussions on water quality objectives and effects for beneficial uses are presented under FONSI Elements 1 and 7 as well as contained in the Sagehen Project Hydrology Report and Appendix D (RCO Analysis) of this EA.

Chapter 4: Agencies and Persons Consulted

Project Scoping

The Sagehen Project scoping letter along with a detailed description of the proposed action was sent to the following agencies, organizations and individuals during the scoping period:

First Name	Last Name	Organization
Nathan	Amboy	USFS
Richard	Anderson	Truckee Mayor
Dick	Artley	
Kaitlin	Backlund	Mountain Area Preservation Foundation
Bill	Banka	
Joe	Barron	Northstar Community Service District
Marie	Barry	Washoe Tribe of Nevada and California
Wanda	Batchelor	Washoe Tribe of Nevada and California
John	Battles	UC Berkeley
Tim	Beals	Sierra County
D.	Beine	40 ac parcel owner
Kris	Boatner	USFS
Rick	Bottoms	USFS
Jim	Branham	Sierra Nevada Conservancy
Steve	Brink	Forest Health
Sue	Britting	Sierra Forest Legacy
Jeff	Brown	UCB Sagehen Field Station
Michael	Campbell	USFS
Lynn	Campbell	Sierra Nevada Conservancy
Steve	Carpenter	
Beth	Christman	Truckee River Watershed Council
R.	Columbro	
Scott	Conway	USFS
Mike	Cotter	USFWS
Darrel	Cruz	Washoe Tribe of Nevada and California
Doug	Cushman	Lahotan Water Board
Scott	Dailey	USFS
Mike	de la Saux	
Carolyn	Dee	Town of Truckee
Lorna	Dobrovolny	CA Dept Fish and Game
E.	Doherty	
Jeff	Dowling	CalFire
Tom	Downing	Sierra Pacific Industries
Gale	Dupree	Sierra Cty Fish & Wildlife Comm
John	Eaton	Mtn Area Preservation Fntn

David	Edelson	
Joel	Erickson	Interested citizen
Don	Errington	USFS
Sharon	Falvey	USFS
Faerthen	Felix	UCB Sagehen Field Station
Tim	Feller	Sierra Pacific Industries
Linda	Ferguson	USFS
Chris	Fitchel	The Nature Conservancy
John	Forno	SPI
Steve	Frisch	Sierra Business Council
Jim	Gaither	The Nature Conservancy
Jon	George	USFS
Julie	Griffith-Flatter	Sierra Nevada Conservancy
Sally	Hallowell	USFS
Chad	Hanson	John Muir Project
Sanford	Haruka	
Sara	Holm	CA Dept Fish and Game
Amy	Horne	Citizen
Bill	Houdyschell	Tahoe Donner
Peter	Huebner	Sierra County Supervisor
Eli	Ilano	USFS
Canjun	James	Sierra Pacific Industries
Sarah	Jones	
John	Jones	TTAirport District
John	Keane	USFS
Joan	Keegan	Sierra Nevada Conservancy
Whitlock	Kevin	
Susie	Kocher	UCD Extension
Mike	Landram	USFS
Tony	Lashbrook	Town of Truckee
David	Lass	Trout Unlimited
Walter	Levings	USFS
Robie	Litchfield	
Lynn	Lorensen	Nevada County RCD & Firesafe Council
Charles	Lorensen	
MAPF	MAPF	Mountain Area Preservation Foundation
Tina	Mark	USFS
Chad	Mellison	USFWS
Darca	Morgan	Sierra Forest Legacy
Katie	Moriarty	
Kathy	Murphy	USFS
Perry	Norris	TDLT
Malcom	North	USFS
Ted	Owens	Nevada County Supervisor
Katy	Parr	USFS

David	Passovoy	CalFire
Laurie	Perrot	USFS
Doug	Praetzel	Sierra Pacific Industries
Bill	Quesnel	
Tom	Quinn	USFS
Marty	Raphael	
Bob	Reugebrink	USFS
Don	Rivenes	FIG
Reina	Rogers	
Tessa	Rognier	USFS
Gary	Roller	
Joanne	Roubique	USFS
David	Saah	
Mark	Shadowens	Northstar Fire
Joe	Sherlock	USFS
Amanda	Shufelberger	Sierra Pacific Industries
Carrie	Smith	USFS
Scott	Stephens	
Chris	Stermer	CA Dept Fish and Game
Jens	Stevens	
Frank	Stewart	
Peter	Stine	USFS
John	Svahn	TDLT
Karen	Szillat	USFS
Alex	Terrazas	Town of Truckee
Craig	Thomas	Sierra Forest Legacy
Biasiolli	Tray	
Truckee	Truckee	Town of Truckee
Deborah	Urich	USFS
Susie	Urie	USFS
Nicole	Vaillant	USFS
	Walker	University of Nevada, Reno
Lisa	Wallace	Truckee River Watershed Council
T.	Weist	CA Dept Fish and Game
Randy	Westmoreland	USFS
Andrew	Winberry	Sierra County
Patrick	Wright	CA Tahoe Conservancy
Don	Yasuda	USFS
Bill	Zielinski	USFS
		CA Forest Foundation

List of Preparers

Name	Interdisciplinary Team Role
Kris Boatner	Interdisciplinary Team Leader
Tim Cardoza	Interdisciplinary Team Leader (10/2012 to 3/2013)
Scott Conway	Vegetation Specialist, Silviculture
Sharon Falvey	Hydrologist
Jon George	Recreation Specialist
Sally Hallowell	GIS Specialist
Roberta Lim	Wildlife Biologist
Tina Mark	Wildlife Biologist
Laurie Perrot	NEPA Specialist
Bob Reugebrink	Engineering Technician
Carrie Smith	Archaeologist
Susan Urie	Botanist
Deborah Urich	Aquatic Biologist
Karie Wiltshire	NEPA Specialist

Chapter 5: Documents Incorporated by Reference, Acronyms Used and Literature Cited

Documents Incorporated by Reference

The following documents were prepared by the interdisciplinary team in analysis of the Sagehen Project and are incorporated by reference into this Environmental Assessment: Silviculture Report, Fire and Fuels Report, Wildlife Biological Evaluation / Assessment, Aquatic Wildlife Biological Evaluation / Assessment, Plants Biological Evaluation / Assessment, Weed Risk Assessment, Migratory Bird Report, Terrestrial and Aquatic Management Indicator Species Reports, Hydrology Report, Soils Report, Economics Report, and Air Quality Report. These documents are part of the project record available by request from the Tahoe National Forest. A cultural resources report was also prepared for the project, but contains sensitive locational information on cultural resources sites which is not available for public release.

Acronyms Used

BMP – Best Management Practice
CWHR – California Wildlife Habitat Relationship
DCA - dense cover area
dbh – diameter at breast height
EA – environmental assessment
EPN – eastside pine
ESO - early seral opening
FONSI – Finding of No Significant Impact
GTR – General Technical Report
HRCA – home range core area (for California spotted owl)
JPN – Jeffrey pine
LCT – Lahontan cutthroat trout
LiDAR – Light Detection and Ranging (laser radar)
LPN – lodgepole pine
MRI – montane riparian
MYLF – Sierra Nevada yellow-legged frog
NADP - National Atmospheric Deposition Network
NEPA - National Environmental Policy Act
NFS – National Forest System
PA/PN - proposed action and purpose and need
PAC - protected activity center (for northern goshawk and California spotted owl)
PSW - Pacific Southwest Research Station
RCA - Riparian Conservation Area

RCO - Riparian Conservation Objective
ROS – Rate of Spread
RFR – red fir
RPM - resource protection measure
SAF – Special Aquatic Feature
SCN – subalpine conifer
SMC – Sierra mixed conifer
SMR – Standard Management Requirement
SNFPA ROD - Sierra Nevada Forest Plan Amendment Record of Decision
SNOTEL - snow telemetry
SPLAT - strategically placed area treatment
TKO - Tractor Keep Out area
TNF - Tahoe National Forest
UC – University of California
USGS - United States Geological Survey
WFR – white fir
WUI – wildland urban interface

Literature Cited

Abdelnour, A., M. Stieglitz, F. Pan, and R. McKane .2011. Catchment hydrological responses to forest harvest amount and spatial pattern, Water Resources, 47, W09521, doi:10.1029/2010WR010165.Bayley Rogers Coe, D., 2006. Sediment Production and Delivery From Forest Roads in the Sierra Nevada, California. Thesis. Spring 2006.Colorado State University, Fort Collins Colorado.

Allen, A. W. 1987. The relationship between habitat and furbearers. Pages 164-179 *in* M. Novak, J.A. Baker, M.E. Obbard and B. Malloch (editors); Wild furbearer management and conservation in North America. Ontario Ministry of Natural Resources, Canada. 1150 pp.

Andruskiw, M., J. M. Fryxell, I. D. Thompson, and J. A. Baker. 2008. Habitat-mediated variation in predation risk by the American marten. Ecology 89(8):2273-2280.

Aubry, K. B. and J. C Lewis. 2003. Extirpation and reintroduction of fishers (*Martes pennanti*) in Oregon: implications for their conservation in the Pacific states. Biological Conservation 114:79-90.

Aubry, K. B., K. S. McKelvey, and J. P. Copeland. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. Journal of Wildlife Management 71(7):2147-2158.

Alt, K. L. 1980. Ecology of the nesting bald eagle and osprey in the Grand Teton-Yellowstone National Parks Complex. M.S. Thesis, Montana State Univ., Bozeman. 95 pp.

Andrew J. M. and J. A. Mosher. 1982. Bald eagle nest site selection and nesting habitat in Maryland. Journal of Wildlife Management 46:383-390.

Anthony, R. G. and F. B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. Journal of Wildlife Management 53:148-159.

Anthony, R. G., R. L. Knight, G. T. Allen, B. R. McClelland and J. I. Hodges. 1982. Habitat use by nesting and roosting bald eagles in the Pacific Northwest. Trans. A. Am. Wildl. Natural Res Conf. 47:332-342.

Archer, D.R. 1989. Flood wave attenuation due to channel and floodplain storage and effects on flood frequency. In: Beven, K.; Carling, P., eds. Floods: hydrological, sedimentological, and geomorphological implications. Chichester,England: John Wiley and Sons: 37–46.

Austin, K. A. 1991. Habitat use of northern goshawk in Southern Cascades. M.S. Thesis. Oregon State University, Corvallis, Oregon. In prep.

Bahls, P. 1992. The status of fish populations and management of high mountain lakes in the western United States. Northwest Science 66(3):183-193.

Bart, J. 1995. Amount of suitable habitat and viability of northern spotted owls. Conservation Biology 9:945-946.

Bateman, M. C. 1986. Winter habitat use, food habits and home range size of the marten, *Martes americana*, in western Newfoundland. Canadian Field Naturalist 100: 58-62.

Bayley, Rogers Coe, D., 2006. Sediment Production and Delivery from Forest Roads in the Sierra Nevada, California. Thesis. Spring 2006.Colorado State University, Fort Collins Colorado.

Beck, T. W., and G. I. Gould, Jr. 1992. Background and the current management situation for the California spotted owl. Pp 37-53 *in* J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck (technical coordinators); The California spotted owl: a technical assessment of its current status. Gen. Tech. Rep. PSW-GTR-133. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Beier, P. and J. E. Drennan. 1997. Forest structure and prey abundance in foraging areas of northern goshawks. Ecological Applications 7:564-571.

Bennett, L. A. and F. B. Samson. 1984. Marten ecology and habitat management in the central Rocky Mountains: problem analysis. USDA Forest Service and Colorado Cooperative Wildlife Research Unit, Colorado State University. Fort Collins, Colorado. 60 pp.

Benson, J. F., J. D. Perrine, R. T. Golightly, Jr., and R. H. Barrett. 2005. Use of cover and response to cover type edges by female Sierra Nevada red foxes in winter. Western North American Naturalist 65(1):127-130.

Berger, L., R. Speare, P. Daszak, D. E. Green, A. A. Cunningham, C. L. Goggin, R. Slocombe, M. A. Ragan, A. D. Hyatt, K. R. McDonald, H. B. Hines, K. R. Lips, G. Marantelli, and H. Parkes. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. Proceedings of the National Academy of Sciences USA 95:9031-9036.

Berger, L., G. Marantelli, L. F. Skerratt, and R. Speare. 2005. Virulence of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* varies with the strain. Diseases of Aquatic Organisms 68:47-50.

Bias, M. A., and R. J. Gutiérrez. 1992. Habitat associations of California spotted owls in the central Sierra Nevada. Journal of Wildlife Management 56(3):584-595.

Bingham, B. B., and B. R. Noon. 1997. Mitigation of habitat "take": application to habitat to Conservation planning. Conservation Biology 11(1):127-139.

Bissonette, J. A., D. J. Harrison, C. D. Hargis, and T. G. Chapin. 1997. The influence of spatial scale and scale-sensitive properties on habitat selection by American marten. Pages 368-385 in J. A. Bissonette, ed., Wildlife and Landscape Ecology. Springer-Verlag, NY.

Blakesley, J. A. and B. R. Noon. 1999. Demographic parameters of the California spotted owl on the Lassen National Forest; preliminary results (1990-1998). Summary Report, February 1999. USDA Forest Service, Pacific Southwest Research Station, Arcata, CA. 44pp.

Blakesley, J. A., B. R. Noon, and D. W. H. Shaw. 2001. Demography of the California spotted owl in northeastern California. The Condor 103:667-677.

Blakesley, J. A. 2003. Ecology of the California spotted owl: Breeding dispersal and associations with forest stand characteristics in northeastern California. Dissertation, Colorado State University, Fort Collins, Colorado.

Blakesley, J. A., B. R. Noon, and D. R. Anderson. 2005. Site occupancy, apparent survival, and reproduction of California spotted owls in relation to forest stand characteristics. Journal of Wildlife Management 69(4):1554-1564.

Blakesley, J. A., M. E. Seamans, M. M. Conner, A. B. Franklin, G. C. White, R. J. Gutiérrez, J. E. Hines, J. D. Nichols, T. E. Munton, D. W. H. Shaw, J. J. Keane, G. N. Steger, B. R. Noon, T. L. McDonald, and S. Britting. 2006a. Demography of the California spotted owl in the Sierra Nevada: Report to the U.S. Fish and Wildlife Service on the January 2006 Meta-Analysis.

Blakesley, J. A., D. R. Anderson, and B. R. Noon. 2006b. Breeding dispersal in the California spotted owl. Condor 108:71-81.

Bloom, P. H., G. R. Stewart and B. J. Walton. 1986. The status of northern goshawk in California, 1981 1983. Adm. Rept. 85-1. State of California, Department of Fish and Game, Sacramento, CA.

Bombay, H. L. 1999. Scale perspectives in habitat selection and reproductive success for willow flycatchers *(Empidonax traillii*) in the centeral Sierra Nevada, California. Master's thesis, California State University, Sacramento. 223 pp.

Bombay, H. L. 2003. Annual report and preliminary demographic analysis for willow flycatcher monitoring in the Central Sierra Nevada in partial fulfillment of contract 53-91S8-01-NRM09 between Dr. Michael L. Morrison under subcontract to Tetra Tech FW, Inc. and USDA Forest Service, Pacific Southwest Region, Vallejo, CA. 50 pp.

Bombay, H. L., M. L. Morrison, D. E. Taylor, and J. W. Cain III. 2001. Annual report and preliminary demographic analysis for willow flycatcher monitoring in the Central Sierra Nevada in partial fulfillment

of contract RFQ-IBET-17-01-053 between University of California, San Diego - White Mountain Research Station and USDA Forest Service, Tahoe National Forest. 46 pp.

Bombay, H. L., M. L. Morrison, and L. S. Hall. 2003. Scale perspectives in habitat selection and animal performance for willow flycatchers (*Empidonax traillii*) in the central Sierra Nevada, CA. Studies in Avian biology No. 26:60-72, 2003.

Bond, M. L., M. E. Seasmans, and R. J. Gutiérrez. 2004. Modeling nesting habitat selection of California spotted owls (*Strix occidentalis occidentalis*) in the central Sierra Nevada using standard forest inventory metrics. Forest Science 50(6):773-780.

Bond, M. L., D. E. Lee, R. B. Siegel, and J. P. Ward, Jr. 2008. Habitat use and selection by California spotted owls in a postfire landscape. Journal of Wildlife Management 73(3): 1116-1124.

Bosch, J., I. Martínez-Solano, and M. García-París. 2001. Evidence of a chytrid fungus infection involved in the decline of the common midwife toad (Alytes obstetricans) in protected areas of central Spain. Biological Conservation 97:331-337.

Bradford, D. F. 1983. Winterkill, oxygen relations, and energy metabolism of a submerged dormant amphibian, *Rana muscosa*. Ecology 64(5):1171-1183.

Bradford, D. F. 1984. Temperature modulation in a high-elevation amphibian, *Rana muscosa*. Copeia 1984(4):966-976.

Bradford, D. F. 1989. Allotropic distribution of native frogs and introduced fishes in high Sierra Nevada lakes of California: implication of the negative effect of fish introductions. Copeia 1989(3):775-778.

Bradford, D. F. 1991. Mass mortality and extinction in a high elevation population of *Rana muscosa.* Journal of Herpetology 25(2):174-177.

Bradford, D. F., F. Tabatabai, and D. M. Graber. 1993. Isolation of remaining populations of the native frog, *Rana muscosa*, by introduced fishes in Sequoia and Kings Canyon National Parks, California. Conservation Biology 7: 882-888.

Bradley, G. A., P. C. Rosen, M. J. Sredl, T. R. Jones, and J. E. Longcore. 2002. Chytridiomycosis in native Arizona frogs. Journal of Wildlife Diseases 38(1):206-212.

Briggs, C. J., V. T. Vredenburg, R. A. Knapp, and L. J. Rachowicz. 2005. Investigating the population-level effects of chytridiomycosis: an emerging infectious disease of amphibians. Ecology 86(12):3149-3159.

British Columbia, Ministry of Forests, December 1989. Developing Timber Harvesting Prescriptions to Minimize Site Degradation- Interior Sites, Land Management Handbook, Field Guide Insert.

Buck, S., C. Mullis and A. Mossman. 1983. Final report: Coral Bottom - Hayfork Bally fisher study. USDA Forest Service. Unpublished report. 133 pp.

Buehler, D. A., T. J. Mersmann, J. D. Fraser, J. K. D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. Journal of Wildlife Management 55:282-290.

Bull, E. L., and T. W. Heater. 2000. Resting and denning sites of American martens in northeastern Oregon. Northwest Science 74(3):179-185.

Bull, E. L., and T. W. Heater. 2001. Home range and dispersal of the American marten in northeastern Oregon. Northwestern Naturalist 82:7-11.

Bull, E. L., T. W. Heater, and J. F. Shepard. 2005. Habitat selection by the American marten in northeastern Oregon. Northwest Science 79(1):37-43.

Buskirk, S. W., S. C. Forrest, M. G. Raphael, and H. J. Harlow. 1989. Winter resting site ecology of marten in the central Rocky Mountains. Journal of Wildlife Management 53(1):191-196.

Buskirk, S. W. and L. F. Ruggiero. 1994. American marten. Pages 7-37 *in* L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski (technical editors); The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. Gen. Tech. Rep. RM-254. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Buskirk, S. W., and W. J. Zielinski. 1997. American marten (*Martes americana*) ecology and conservation. Pages 17-22 *in* J.E. Harris and C.V. Ogan (editors). Mesocarnivores of northern California: biology, management, and survey techniques, workshop manual. August 12-15, 1997. Humboldt State University, Arcata, California. The Wildlife Society, California North Coast Chapter, Arcata, California. 127 pp.

Busse, M.D., C. Shestak, E. Knapp, G. Fiddler, and K. Hubbert. 2005. Lethal soil heating during burning of masticated fuels: effects of soil moisture and texture. International Journal of Wildand Fire. 2005. **14** 267-276.www.publish.csiro.au/journals/ijwf.

Busse M, et.al. 2010. Soil Physical Properties Regulate Lethal Heating during Burning of Woody Residues. Soil Sci. Soc. Am. J. 74:947–955. Published online 4 March 2010 doi:10.2136/sssaj2009.0322 Received 31 Aug. 2009

Butts, T. W. 1992. Wolverine (*Gulo gulo*) biology and management: A literature review and annotated bibliography. Unpublished paper for the U.S. Forest Service. Northern Region.

Cain, J. W., III, M. L. Morrison, and H. L. Bombay. 2003. Predator activity and nest success of willow flycatchers and yellow warblers. Journal of Wildlife Management 67(3):600-610.

Cain, J. W., III., K. S. Smallwood, M. L. Morrison, and H. L. Loffland. 2006. Influence of mammal activity on nesting success of passerines. Journal of Wildlife Management 70(2):522-531.

California Regional Water Quality Control Board Lahontan Region. 2000. Water quality control plan for the Lahontan Region North and South Basins. State of California, South Lake Tahoe, CA.

Calkin, David E.; Ager, Alan A.; Gilbertson-Day, Julie, eds. 2010. Wildfire risk and hazard: procedures for the first approximation. Gen. Tech. Rep. RMRS-GTR-235. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 62.

Call, D. R. 1990. Home range and habitat use by California spotted owls in the central Sierra Nevada. Master's Thesis. Humboldt State University, Arcata CA. 83 pp.

Call, D. R., R. J. Gutiérrez, and J. Verner. 1992. Foraging habitat and home-range characteristics of California spotted owls in the Sierra Nevada. Condor 94:880-888.

Campbell, G.S., J.D. Jungbauer, Jr., K.L. Bristow, and R.D. Hungerford. 1995. Soil temperature and water content beneath a surface fire. Soil Sci. 159:363–374.

Chapel, M., A. Carlson, D. Craig, T. Flaherty, C. Marshall, M. Reynolds, D. Pratt, L. Pyshora, S. Tanguay and W. Thompson. 1992. Recommendations for managing late-seral-stage forest and riparian habitats on the Tahoe National Forest. Located at: USDA Forest Service, Tahoe National Forest, Nevada City, California. 31pp.

Chapin, T. G., D. J. Harrison, D. M. Phillips. 1997. Seasonal habitat selection by marten in an untrapped forest preserve. Journal of Wildlife Management 61:707-717.

Chapin, T. G., D. J. Harrison, and D. D. Katnik. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. Conservation Biology 12(6):1327-1337.

Chatfield, A. H. 2005. Habitat Selection by a California Spotted Owl Population: A Landscape Scale Analysis Using Resource Selection Functions. Master's Thesis, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota.

Copeland, J. P., and T. E. Kucera. 1997. Wolverine (*Gulo gulo*). Pages 23-33 *in* J. E. Harris and C. V. Ogan (editors). Mesocarnivores of northern California: biology, management, and survey techniques, workshop manual. August 12-15, 1997. Humboldt State University, Arcata, California. The Wildlife Society, California North Coast Chapter, Arcata, California. 127 pp.

Copeland, J. P., J. M. Peek, C. R. Groves, W. E. Melquist, K. S. McKelvey, G. W. McDaniel, C. D. Long, and C. E. Harris. 2007. Seasonal habitat associations of the wolverine in central Idaho. Journal of Wildlife Management 71(7):2201-2212.

Croke J, Mockler S. 2001. Gully initiation and road-to-stream linkage in a forested catchment, southeastern Australia. Earth Surface Processes and Landforms. 26: 205-217.

Carey, C., N. Cohen, and L. Rollins-Smith. 1999. Amphibian declines: an immunological perspective. Developmental and Comparative Immunology 23:459-472.

Coppeto, S. A., D. A. Kelt, D. H. Van Vuren, J. A. Wilson, and S. Bigelow. 2006. Habitat associations of small mammals at two spatial scales in the northern Sierra Nevada. Journal of Mammalogy 87(2):402 413.

Cushman, S. A., M. G. Raphael, L. F. Ruggiero, A. S. Shirk, T. N. Wasserman, and E. C. O'Doherty. 2011. Limiting factors and landscape connectivity: the American marten in the Rocky Mountains. Landscape Ecology. 26: 1137-1149.

Damiani, C., D. C. Lee, and S. L. Jacobson. 2007. Effects of noise disturbance on northern spotted owl reproductive success. Unpublished Report: Northwest Forest Plan Administrative Study Final Report; available from: USDA Forest Service Pacific Southwest Research Station, Arcata, Ca. 16pp.

Davidson, C. 2004. Declining downwind: amphibian population declines in California and historical pesticide use. Ecological Applications 14(6):1892-1902.

Davidson, C., and R. A. Knapp. 2007. Multiple stressors and amphibian declines: dual impacts of pesticides and fish on yellow-legged frogs. Ecological Applications 17(2):587-597.

Drost, C. A., and G. M. Fellers. 1996. Collapse of a regional frog fauna in the Yosemite area of the California Sierra Nevada, USA. Conservation Biology 10(2):414-425.

Debyle, N.V. 1985c. Wildlife. In: DeByle, N.V.; Winokur, R.P., eds. Aspen: ecology and management in the western United States. GTR-RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 135-152.

Dietrich, P. J. 1981. Historic range of breeding bald eagles in California. Unpublished manuscript. Redding, CA. 17 pp.

Dietrich, P. J. 1982. Results of California winter bald eagle survey--1982. U. S. Dept. Int. Fish Wildl. Serv., Sacramento, CA. 16 pp.

Dietrich, P. 1990. The California bald eagle management plan—draft; unpublished report. Available at the Tahoe National Forest Supervisor's Office, Coyote Street, Nevada City, CA. 71p.

Drew, G. S. 1995. Winter habitat selection by American marten (Martes americana) in Newfoundland: why old growth? Dissertation, Utah State University, Logan, Utah. 100 pp.

Drew, R. E., J. G. Hallett, K. B. Aubry, K. W. Cullings, S. M. Koepf, and W. J. Zielinski. 2003. Conservation genetics of the fisher (*Martes pennanti*) based on mitochondrial DNA sequencing. Molecular Ecology 12:51-62.

Dumyahn, J. B., P. A. Zollner, and J. H. Gilbert. 2007. Winter home-range characteristics of American marten (*Martes americana*) in northern Wisconsin. American Midland Naturalist 158:382-394.

Duncan Furbearer Interagency Workgroup. 1989. Workgroup assembled to review the proposed Duncan Timber Sale, Tahoe National Forest and formulate proposed Management Guidelines. Members present: Slader Buck, Reginald Barrett, Terri Simon-Jackson, Gordon Gould, Ron Schlorff, Jeff Finn, Joelle Buffa, Maeton Freel, Jeff Mattison, Mike Chapel, Mariana Armijo, Julie Lydick and Phil Turner.

Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299 p.

Fellers, G. M., D. E. Green, and J. E. Longcore. 2001. Oral chytridiomycosis in the mountain yellow-legged frog (*Rana muscosa*). Copeia 2001(4):945-953.

Fellers, G. M., D. F. Bradford, D. Pratt, and L. Long Wood. 2007. Demise of repatriated populations of mountain yellow-legged frogs (*Rana muscosa*) in the Sierra Nevada of California. Herpetological Conservation and Biology 2(1):5-21.

Finlay, J. C., and V. T. Vredenburg. 2007. Introduced trout sever trophic connections in watersheds: consequences for a declining amphibian. Ecology 88(9):2187-2198.

Finney, M.A. 2001. Design of Regular Landscape Fuel Treatment Patterns for Modifying Fire Growth and Behavior. Forest Service 47(2) 2001.

Fowler, C. 1988. Habitat capability model for the northern goshawk. USFS, Tahoe National Forest, Nevada City, CA. 21 pp.

Frandsen, W.H., and K.C. Ryan. 1986. Soil moisture reduces belowground heat flux and soil temperatures under a burning fuel pile. Can. J. For. Res. 16:244–248.

Freel, M. 1991. A literature review for management of fisher and marten in California. Unpubl. Document, USDA Forest Service, Pacific Southwest Region.

Frest, T. J. and E. J. Johannes. 1993. Mollusk Species of Special Concern Within the Range of the Northern Spotted Owl. Final Report to the Forest Ecosystem Management Working Group, USDA, Forest Service. Deixis Consultants, Seattle WA. 98 pages.

Fry, W. 1923. The wolverine. California Fish and Game 9(4):129-134.

Fuller, A. K., and D. J. Harrison. 2005. Influence of partial timber harvesting on American martens in north-central Maine. Journal of Wildlife Management 69(2):710-722.

Fuller, A. K. 2006. Multi-scalar responses of forest carnivores to habitat and spatial pattern: case studies with Canada lynx and American martens. Dissertation, University of Maine, Orono, Maine.

Ganey, J. L., W. M. Block, and S. H. Ackers. 2003. Structural characteristics of forest stands within home ranges of Mexican spotted owls in Arizona and New Mexico. Western Journal of Applied forestry **18**:189 198.

Garbrecht, J. 1991. Effects of spatial accumulation of runoff on watershed response. Journal of Environmental Quality. 20: 31–35.

Garcia-Feced, C., D. J. Tempel, and M. Kelly. 2011. LiDAR as a tool to characterize wildlife habitat: California spotted owl nesting habitat as an example. Journal of Forestry **109:**436-443.

Glenn, E. M., R. G. Anthony, E. D. Forsman. 2010. Population trends in northern spotted owls: Associations with climate in the Pacific Northwest. Biological Conservation **143**:2543-2552.

Gomez, G.A., Powers, R.F., Singer, M.J., Horwath,W.R., 2002. Soil compaction effects on growth of young ponderosa pine following litter removal in California's Sierra Nevada. Soil Sci. Soc.Am. J. 66, 1334–1343.

Green, G. A., H. L. Bombay, M. L. Morrison. 2003. Conservation assessment of the willow flycatcher in the Sierra Nevada. USDA Forest Service, Pacific Southwest Region, Vallejo, CA. 62 pp.

Grinnell, J. 1913. (*as cited* in Shempf and White 1977) A distributional list of the mammals of California. Calif. Acad. Sci. Proc. Ser. 4, 3:265-390.

Grinnell, J. 1933. (*as cited* in Shempf and White 1977) Review of the recent mammal fauna of California. Univ. Calif. Publ. Zool. 40(2):71-234.

Grinnell, J., J. S. Dixon, and J.M. Linsdale. 1937. Fur-bearing mammals of California. University of California Press, Berkeley, California.

Grant, Gordon E.; Lewis, Sarah L.; Swanson, Frederick J.; Cissel, John H.;McDonnell, Jeffrey J. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p.Hammond.S.E, and J.G.Harmon. 1998. Publications Document Floods of January 1997 in California and Nevada: U.S. Geological Survey Fact Sheet FS-093-98, 4 p.

Greacen, E.L., Sands, R., 1980. Compaction of forest soils. Areview. Aust. J. Soil Res. 18, 163–189.

Grubb, T. G. 1976. A survey and analysis of bald eagle nesting in Western Washington. M.S. Thesis, Univ. Washington, Seattle. 87 pp.

Grubb, T. G. 1995a. Constructing bald eagle nests with natural materials. USDA Forest Service research note RM-RN-535, 8p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Grubb, T. G. 1995b. Food habits of bald eagles breeding in the Arizona Desert. Wilson Bulleton 107:258 274.

Grubb, T. G., W. W. Bowerman, J. P. Giesy and G. A. Dawson. 1992. Responses of breeding bald eagles, *Haliaeetus leucocephalus*, to human activities in northcentral Michigan. Canadian Field-Naturalist 106(4):443-453.

Grubb, T. G. and C. E. Kennedy. 1982. Bald eagle winter habitat on southwestern Nationl Forests. USDA Forest Service Research paper RM-237, 13p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Grubb, T. G. and R. M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Gutiérrez, R. J., J. Verner, K. S. McKelvey, B. R. Noon, G. N. Steger, D. R. Call, W. S. LaHaye, B. B. Bingham, and J. S. Senser. 1992. Habitat Relations of the California Spotted Owl. Pages 79-98 *in* J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck (technical coordinators); The California spotted owl: a technical assessment of its current status. Gen. Tech. Rep. PSW-GTR-133. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Gutiérrez, R. J., M. E. Seamans and M. Z. Peery. 1999. Population ecology of the California spotted owl in the central Sierra Nevada: annual results 1998. Annual progress Report March 1999. Region 5, USDA Forest Service. 20pp.

Gutiérrez, R. J., and G. F. Barrowclough. 2005. Redefining the distributional boundaries of the northern and California spotted owls: implications for conservation. The Condor 107:182-187.

Hanes R. and Poff, R. 1989. Descriptive Legend for the Soil Survey of the Sagehen Area, Tahoe National Forest Area, California.

Hargis, C. D. and J. A. Bissonette. 1995. The effect of forest fragmentation on American marten populations and prey availability. Final report for the Utah Division of Wildlife Resources, Wasatch Cache National Forest, Ashley National Forest, Utah Wilderness Association (Contract No. 91-9166). December 31, 1995. 96pp.

Hargis, C. D. and D. R. McCullough. 1984. Winter diet and habitat selection of marten in Yosemite National Park. Journal of Wildlife Management 48(1):140-146.

Hargis, C. D. and J. A. Bissonette. 1997. The influence of forest fragmentation and prey availability on American marten populations: a landscape level analysis. Pages 437-451 *in* G. Proulx, H. N. Bryant and P. M. Woodard (editors). *Martes*: taxonomy, ecology, techniques, and management. Proceedings of the Second International *Martes* symposium. The Provincial Museum of Alberta. Edmonton, Alberta, Canada. 474 p.

Hargis C. D., J. A. Bissonette, and D. L. Turner. 1999. The influence of forest fragmentation and landscape pattern on American martens. Journal of Applied Ecology 36:157-172.

Hargis, C. D., R. D. Perloff, and C. McCarthy. 1991. Home ranges and habitats of northern goshawks in eastern California. Draft Rep. C.D. Hargis, Dept. Fish and Wildl., Utah State Univ. Logan, UT. 17 pp.

Hartford, R.A.; Frandsen, W.H. 1992. When it's hot, it's hot … or maybe it's not (surface flaming may not portend extensive soil heating). International Journal of Wildland Fire. 2: 139–144.

Hayes, M. P., and M. R. Jennings. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology 20(4):490-509.

Hedmark, E., J. Persson, P. Segerström, A. Landa, and H. Ellegren. 2007. Paternity and mating system in wolverines Gulo gulo. Wildlife Biology 13(Suppl. 2):13-30.

Heinemeyer, K.S. 2002. Translating individual movements into population patterns: American martens in fragmented forested landscapes. Doctoral dissertation. University of California, Santa Cruz.

HFQLG, 2006. 2005. HFQLG Soil Monitoring Report, March 2006. Unpublished.

HFQLG, 2007. 2006. HFQLG Soil Monitoring Report, January 2008. Unpublished.

HFQLG 2010. Monitoring Stream Condition Inventory (SCI) Summary 2009, January 2010. Unpublished.

HFQLG, 2011a. 2010. Monitoring Stream Conditions Inventory SCI Summary. January, 2011.Unpublished.

HFQLG, 2011b. Question 17 Monitoring Results .2010. January 3, 2011. Joseph Hoffman, Plumas NF hydrologist. Unpublished.

HFQLG, 2011c. 2010 HFQLG Soil Monitoring Report, February 2011. Unpublished.

Hornocker, M. G. and H. S. Hash. 1981. Ecology of the wolverine in northwestern Montana. Canadian Journal of Zoology 59:1286-1301.

Hubbert K., M. Busse, S. Overby, C. Shestak, 2012. USDA Forest Service, Pacific Southwest Research Station, USDA Forest Service, Rocky Mountain Research Station. Poster Presentation. http://www.fs.fed.us/psw/partnerships/tahoescience/r9_pile_burning_effects.shtml

Huffman, E.L. et.al. 2001. Strength and persistence of fire-induced soil hydrophobicity under ponderosa and lodgepole pine, Colorado Front Range. Hydrol. Process. 15, 2877–2892 (2001) DOI: 10.1002/hyp.379.

Hunsaker, C. T., B. B. Boroski, and G. N. Steger. 2002. Relations between canopy cover and the occurrence and productivity of California spotted owls *in* J. M. Scott, P. J. Hegland, and M. L. Morrison (Eds.); Predicting Species Occurrences: Issues of Accuracy and Scale. Island Press, Washington, DC, pp. 687-700.

Hurteau, M. and North M.P., 2010. Carbon recovery rates following different wildfire risk mitigation treatments. For. Ecol. Manage., 260, pp. 930–937.

Hurteau, M. and North, M.P., 2011. High-severity wildfire effects on carbon stocks and emissions in fuels treated and untreated forest. For. Ecol. Manage., 261, pp. 1115–1120.

Innes, R. J., D. H. Van Vuren, D. A. Kelt, M. L. Johnson, J. A. Wilson, and P. A. Stine. 2007. Habitat associations of dusky-footed woodrats (*Neotoma fuscipes*) in mixed-conifer forest of the northern Sierra Nevada. Journal of Mammology 88(6):1523-1531.

Innes, R. J., D. H. Van Vuren, and D. A. Kelt. 2008. Characteristics and use of tree houses by dusky footed woodrats in the northern Sierra Nevada. Northwestern Naturalist 89:109-112.

Irwin, L. L., L. A. Clark, D. C. Rock, and S. L. Rock. 2007. Modeling Foraging Habitat of California Spotted Owls. Journal of Wildlife Management 71(4):1183-1191.

Ishak, H. D., J. P. Dumbacher, N. L. Anderson, J. J. Keane, G. Valkiūnas, S. M. Haig, L. A. Tell, and R. N. M. Sehgal. 2008. Blood parasites in owls with conservation implications for the spotted owl (*Strix occidentalis*). PLoS ONE 3(5): e2304. Doi:10.1371/journal.pone.0002304.

Jennings, M. 1993. Current Status of 25 species of California Herps. Presented at the 1993 Wildlife Society Western Section Meeting.

Jennings, M. R. and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California.

Jones, F. L. 1950. Recent records of the wolverine (*Gulo luscus luteus*) in California. California Fish and Game 36:320-322.

Jones, F. L. 1955. Records of southern wolverine, *Gulo luscus luteus*, in California. Journal of Mammalogy 36(4):569.

Jones, J. A., and D. A. Post. 2004. Seasonal and successional streamflow response to forest cutting and regrowth in the northwest and eastern United States, Water Resour. Res., 40, W05203, doi:10.1029/2003WR002952.

Jury, W.A., Gardner, W.R., and Gardener, W.H. 1991. Soil Physics. John Wiley and Sons.

Keane, J. 2013. California Spotted Owl: Scientific Considerations for Forest Planning. Chapter 7.2, pages 1-24 in Long, Jonathan; Skinner, Carl; North, Malcolm; Winter, Pat; Zielinski, Bill; Hunsaker, Carolyn; Collins, Brandon; Keane, John; Lake, Frank; Wright, Jessica; Moghaddas, Emily; Jardine, Angela; Hubbert, Ken; Pope, Karen; Bytnerowicz, Andrzej; Fenn, Mark; Busse, Matt; Charnley, Susan; Patterson, Trista; Quinn-Davidson, Lenya; Safford, Hugh; chapter authors and Synthesis team members. USDA Forest Service Pacific Southwest Research Station. 2013. Science Synthesis to support Forest Plan Revision in the Sierra Nevada and Southern Cascades. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 504 p.

Kirk, T. A. 2007. Landscape-scale habitat associations of the American marten (*Martes americana*) in the greater southern Cascades region of California. M.S. Thesis, Humboldt State University, Arcata, California, 103 pp.

Koehler, G. M., W. R. Moore and A. R. Taylor. 1975. Preserving the pine marten: management guidelines for western forests. Western Wildlands 2:31-36.

Kovach, S. D. 1981. Wolverine, *Gulo gulo*, records for the White Mountains, California. California Fish and Game 67(2):132-133.

Knapp, E. et al. 2011. Behavior and effects of prescribed fire in masticated fuelbeds. International Journal of Wildland Fire 20,932-945.

Knapp, R. A. 1993. Non-native trout in natural lakes of the Sierra Nevada: An analysis of their distribution and impacts on native aquatic biota. Sierra Nevada Ecosystem Project: Final Report to Congress, Volume III, Chapter 8, pp 363-407. Davis: University of California, Centers for Water and Wildland Resources.

Knapp, R. 1994. Wilderness Record. Volume 19, Number 2. Davis, California.

Knapp, R. A., and K. R. Matthews. 2000. Non-native fish introductions and the decline of the mountain yellow-legged frog from within protected areas. Conservation Biology 14(2):428-438.

Knapp, R. A., K. R. Matthews, H. K. Preisler, and R. Jellison. 2003. Developing probabilistic models to predict amphibian site occupancy in a patchy landscape. Ecological Applications 13(4):1069-1082.

Knapp, R. A., D. M. Boiano, and V. T. Vredenburg. 2007. Removal of nonnative fish results in population expansion of a declining amphibian (mountain yellow-legged frog, Rana muscosa). Biological Conservation 135:11-20.

Knowles, Constance. 1942. Lumbering history of the Truckee Basin: 1856-1936. Division of Forest Survey, California Forest and Range Experiment Station, Berkeley, CA.

Krebs, J., E. C. Lofroth, and I. Parfitt. 2007. Multiscale habitat use by wolverines in British Columbia, Canada. Journal of Wildlife Management 71(7):2180-2192.

Krohn, W. B., Arthur, S. M., Paragi, T. F. 1994. Mortality and vulnerability of a heavily trapped fisher population. Pp 137-148 *in* S.W. Buskirk, Harestad, A.S., Raphael, M.G., comps., eds. Martens, Sables and Fishers: Biology and Conservation. Cornell University Press, Ithaca, New York.

Krohn, W. B., K. D. Elowe, and R. B. Boone. 1995. Relations among fishers, snow, and martens: development and evaluation of two hypotheses. Forestry Chronicle 71(1):97-105.

Krohn, W. B., W. J. Zielinski, and R. B. Boone. 1997. Relations among fishers, snow, and martens in California: results from small-scale spatial comparisons. Pp. 211-232 *in* G. Proulx, H. N. Bryant, and P. M. Woodard (editors); *Martes*: taxonomy, ecology, techniques, and management. Proceedings of the Second International *Martes* Symposium. Provincial Museum of Alberta, Edmonton, Alberta, Canada.

Krohn, W., C. Hoving, D. Harrison, D. Phillips, and H. Frost. 2005. *Martes* foot-loading and snowfall patterns in eastern North America. Pp. 115-131 *in* D. J. Harrison, A. K. Fuller, and G. Proulx (editors); Martens and Fishers (*Martes*) in Human-Altered Environments. Springer-Verlag, New York, New York.

Kucera, T. E., W. J. Zielinski, and R. H. Barrett. 1995. Current distribution of the American marten, *Martes americana*, in California. California Fish and Game 81(3):96-103.

Lamberson, R. H., R. L. Truex, W. J. Zielinski, D. C. Macfarlane. 2000. Preliminary analysis of fisher population viability in the southern Sierra Nevada. Unpublished document, February 15, 2000. Available at U.S. Department of Agriculture, Forest Service, Tahoe National Forest Supervisor's Office, Nevada City, California. 20pp.

Lofroth, E. C., J. A. Krebs, W. L. Harrower, and D. Lewis. 2007. Food habits of wolverine *Gulo gulo* in montane ecosystems of British Columbia, Canada. Wildlife Biology 13(Suppl. 2):31-37.

Long, Jonathan; Skinner, Carl; North, Malcolm; Winter, Pat; Zielinski, Bill; Hunsaker, Carolyn; Collins, Brandon; Keane, John; Lake, Frank; Wright, Jessica; Moghaddas, Emily; Jardine, Angela; Hubbert, Ken; Pope, Karen; Bytnerowicz, Andrzej; Fenn, Mark; Busse, Matt; Charnley, Susan; Patterson, Trista; Quinn Davidson, Lenya; Safford, Hugh; chapter authors and Synthesis team members. USDA Forest Service Pacific Southwest Research Station. 2013. Science Synthesis to support Forest Plan Revision in the Sierra Nevada and Southern Cascades. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 504 p.

LaHaye, W. S., R. J. Gutiérrez, and D. R. Call. 1997. Nest-site selection and reproductive success of California spotted owls. Wilson Bulletin 109(1):42-51.

LaHaye, W. S., G. S. Zimmerman, and R. J. Gutiérrez. 2004. Temporal variation in the vital rates of an insular population of spotted owls (*Strix occidentalis occidentalis*): Contrasting effects of weather. The Auk 121(4):1056-1069.

Laymon, S. A. 1988. The ecology of the spotted owl in the central Sierra Nevada, California. University of California, Berkeley. PhD Dissertation. 285pp.

Lee, D. C., and L. L. Irwin. 2005. Assessing risks to spotted owls from forest thinning in fire-adapted forests of the western United States. Forest Ecology and Management 211:191-209.

Lee, D. E., and W. D. Tietje. 2005. Dusky-footed woodrat demography and prescribed fire in a California oak woodland. Journal of Wildlife Management 69(2):1211-1220.

Livezey, K. B. 2007. Barred owl habitat and prey: a review and synthesis of the literature. Journal of Raptor Research 41(3):177-201.

Livezey, K. B., M. F. Elderkin, P. A. Cott, J. Hobbs, and J. P. Hudson. 2008. Barred owls eating worms and slugs: the advantage in not being picky eaters. Northwestern Naturalist 89:185-190.

Livezey, K. B. 2009. Range expansion of barred owls, part I: chronology and distribution. American Midland Naturalist 161:49-56.

Lehman, R. N. 1979. A survey of selected habitat features of 95 bald eagle nest in California. Calif. Dept. Fish and Game. Wildl. Manage. Branch Admin. Rep. 79-1, Sacramento. 23 pp.

Lehman, R. N., D. E. Craigie, P. L. Colins and R. S. Griffen. 1980. An analysis of habitat requirements and site selection criteria for nesting bald eagle in California. Report by Wilderness Research Institute, Arcata, CA. for U.S. Forest Service, Region 5, San Francisco, CA. 106 pp.

Longcore, J. E., A. P. Pessier, and D. K. Nichols. 1999. *Batrachochytrium dendrobatidis* gen. et sp. nov., a chytrid pathogenic to amphibians. Mycologia 91:219-227.

Luce CH, Black TA. 2002a. Spatial and temporal patterns in erosion from forest roads. In Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas. Water Science and Application 2, Wigmosta MS, Burges SJ (eds). American Geophysical Union, Washington, DC; 165-178.

Luce CH, Black TA. 1999. Sediment production from forest roads in western Oregon. Water Resources Research. 35(8): 2561-2570.

MacDonald LH, Coe D, Litschert S. 2004. Assessing cumulative watershed effects in the Central Sierra Nevada: hillslope measurements and catchment-scale modeling. In Proceedings of the Sierra Nevada Science Symposium: Science for Management and Conservation. USDA Forest Service General Technical Report, PSW-GTR-193: 149-157.

Macey, J. R., J. L. Strasburg, J. A. Brisson, V. T. Vredenburg, M. Jennings, and A. Larson. 2001. Molecular phylogenetics of western North American frogs of the *Rana boylii* species group. Molecular Phylogenetics and Evolution 19(1):131-143.

Martin, D. L. 1992. Sierra Nevada Anuran Guide. Canorus, LTD. Ecological Research Team. San Jose, CA.

Martin, D. L. 1994. Personal communication regarding mountain yellow-legged frog habitat needs.

Martin, S. K., and R. H. Barrett. 1991. Resting site selection by marten at Sagehen Creek, California. Northwestern Naturalist 72:37-42.

Martin, Sandra Kay. 1987. The ecology of the pine marten (*Martes americana*) at Sagehen Creek, California. PhD Dissertation. University of California, Berkeley, CA. 223 p.

Matthews, K. R., and K. L. Pope. 1999. A telemetric study of the movement patterns and habitat use of Rana muscosa, the mountain yellow-legged frog, in a high-elevation basin in Kings Canyon National Park, California. Journal of Herpetology 33(4):615-624.

Matthews, K. R. 2003. Response of mountain yellow-legged frogs, Rana muscosa, to short distance translocation. Journal of Herpetology 37(3):621-626.

McKelvey, K. S., K. B. Aubry, and M. K. Schwartz. 2008. Using anecdotal occurrence data for rare or elusive species: the illusion of reality and a call for evidentiary standards. BioScience 58(6):549-555.

Meyer, M. D., D. A. Kelt, and M. P. North. 2005a. Nest trees of northern flying squirrels in the Sierra Nevada. Journal of Mammology 86(2):275-280.

Meyer, M. D., M. P. North, and D. A. Kelt. 2005b. Short-term effects of fire and forest thinning on truffle abundance and consumption by *Neotamias speciosus* in the Sierra Nevada of California. Canadian Journal of Forest Research 35:1061-1070.

Meyer, M. D., and M. P. North. 2005. Truffle abundance in riparian and upland mixed-conifer forest of California's southern Sierra Nevada. Canadian Journal of Botany 83:1015-1020.

Meyer, M. D., M. P. North, and D. A. Kelt. 2007a. Nest trees of northern flying squirrels in Yosemite National Park, California. The Southwestern Naturalist 52(1): 157-161.

Meyer, M. D., D. A. Kelt, and M. P. North. 2007b. Microhabitat associations of northern flying squirrels in burned and thinned forest stands of the Sierra Nevada. American Midland Naturalist 157:202-211.

Moen, C. A. and R. J. Gutiérrez. 1997. California spotted owl habitat selection in the central Sierra Nevada. Journal of Wildlife Management 61(4):1281-1287.

Moriarty, K. M., W. J. Zielinski, A. G. Gonzales, T. E. Dawson, K. M. Boatner, C. A. Wilson, F. V. Schlexer, K. L. Pilgrim, J. P. Copeland, and M. K. Schwartz. 2009. Wolverine confirmation in California after nearly a century: native or long-distance immigrant? Northwest Science 83(2):154-162.

Moriarty, K. M. 2009. American marten distributions over a 28 year period: relationships with landscape change in Sagehen Creek Experimental Forest, California, USA. M.S. Thesis, Oregon State University, Corvallis, Oregon.

Moriarty, K. M., W. J. Zielinski, and E. D. Forsman. 2011. Decline in American marten occupancy rates at Sagehen Experimental Forest, California. Journal of Wildlife Management 75:1774-1787.

Moriarty, Katie M. 2011. Personal communication as part of the Sagehen Collaborative Planning process.

Moritz, C., J. L. Patton, C. J. Conroy, J. L. Parra, G. C. White, and S. R. Beissinger. 2008. Impact of a century of climate change on small-mammal communities in Yosemite National Park, USA. Science 322:261-264.

Mowat, G. 2006. Winter habitat associations of American martens *Martes americana* in interior wet Belt forests. Wildlife Biology 12(1):51-61.

Munton, T. E., K. D. Johnson, G. N. Steger, and G. P. Eberlein. 2002. Diets of California spotted owls in the Sierra National Forest. Pp 99-105 *in* J. Verner (technical editor); Proceedings of a Symposium on the Kings River Sustainable Forest Ecosystem Project: Progress and Current Status. Gen. Tech. Rep. PSW GTR-183. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Muths, E., P. S. Corn, A. P. Pessier, and D. E. Green. 2003. Evidence for disease-related amphibian decline in Colorado. Biological Conservation 110:357-365.

Myrick, David F. 1992. Railroads of Nevada and eastern California. volume I: the northern railroads. University of Nevada Press, Reno, NV.

North, M., G. Steger, R. Denton, G. Eberlein, T. Munton, and K. Johnson. 2000. Association of weather and nest-site structure with reproductive success in California spotted owls. Journal of Wildlife Management 64(3):797-807.

North, Malcolm P. 2006. Restoring forest health: fire and thinning effects on mixed-conifer forests. Science Perspectives PSW-SP-007. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 6 p.

North, Malcolm; Stine, Peter; O'Hara, Kevin; Zielinski, William; Stephens, Scott. 2009. An ecosystem management strategy for Sierran mixed-conifer forests. Gen. Tech. Rep. PSW-GTR-220. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 49 p.

North, Malcolm, ed. 2012. Managing Sierra Nevada forests. Gen. Tech. Rep. PSW-G237.Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 184 p.

North, M., editor. 2012. Managing Sierra Nevada Forests. Gen. Tech. Rep. PSW-GTR-237. U.S. Department of Agriculture, Forest Service, Pacfic Southwest Research Station, Albany, CA. 184 p.

Oli, M. K., and F. S. Dobson. 2001. Population cycles in small mammals: the α-hypothesis. Journal of Mammalogy 82(2):573-581.

Oullet, M., I. Mikaelian, B. D. Pauli, J. Rodrigue, and D. M. Green. 2005. Historical evidence of widespread chytrid infection in North American amphibian populations. Conservation Biology 19(5):1431-1440.

Page-Dumroese D. S., Martin F. Jurgensen, Allan E. Tiarks, Felix Ponder, Jr., Felipe G. Sanchez, Robert L. Fleming, J. Marty Kranabetter, Robert F. Powers, Douglas M. Stone, John D. Elioff, and D. Andrew Scott. 2006. Soil physical property changes at the North American Long-Term Soil Productivity study sites: 1 and 5 years after compaction. Can. J. For. Res. 36: 551–564.

Perry Timothy D. 2007. Do Vigorous Young Forests Reduce Streamflow? Results from up to 54Years of Streamflow Records in Eight Paired-watershed Experiments in the H. J. Andrews and South Umpqua Experimental Forests. MS Thesis, Department of Geography. Oregon State University, December 2007.

Plotnikoff, M., Schmidt, M., Bulmer, C., and Curran, M. 1999. Forest productivity and soil conditions on rehabilitated landings: interior British Columbia. Extension Note 40. British Columbia Ministry of Forests, Research Branch, Victoria, B.C.

Pope, K. L., and K. R. Matthews. 2001. Movement ecology and seasonal distribution of mountain yellow-legged frogs, Rana muscosa, in a high-elevation Sierra Nevada basin. Copeia 2001(3):787-793.

Pope, K. L., and K. R. Matthews. 2002. Influence of anuran prey on the condition and distribution of Rana muscosa in the Sierra Nevada. Herpetologica 58(3):354-363.

Potvin, F., L. Belanger and K. Lowell. 2000. Marten habitat selection in a clear-cut boreal landscape. Conservation Biology 14:844-857.

Powell, R. A. 1979. Mustelid spacing patterns: variations on a theme by Mustela Zhurnal Tierpsychologie. 50:153-165.

Powell, R. A. 1994. Structure and spacing in *Martes* populations. Pages 101-121 *in* S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell (editors); Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press, Ithaca, New York.

Powell, R. A., S. W. Buskirk, and W. J. Zielinski. 2003. Fisher and marten (*Martes pennanti* and *Martes americana*). Pp. 635-649 *in* G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, eds. Wild Mammals of North America: Biology, Management, and Conservation, 2nd Edition. The Johns Hopkins University Press, Baltimore, Maryland, and London, England.

Powers, Robert F., David H. Alban, Gregory A. Ruark, Allan E. Tiarks, Charles B. Goudey, Jerry F. Ragus, Walter E. Russell, 1989. Evaluating Timber Management Impacts on Long-Term Soil Productivity: A Research and National Forest System Cooperative Study. On file, PSW Redding.

Powers, Robert F., et.al. 2005. The North American Long-Term Soil Productivity Experiment: Findings from the first decade of research. Forest Ecology and Management 220 (2005) 31-50.

Powers, Robert. 2005. Presentation USDA FS Soils Conference, Redding CA. 2005. Unpublished.

Rachowicz, L. J., and V. T. Vredenburg. 2004. Transmission of *Batrachochytrium dendrobatidis* within and between amphibian life stages. Diseases of Aquatic Organisms 61:75-83.

Rachowicz, L. J., R. A. Knapp, J. A. T. Morgan, M. J. Stice, V. T. Vredenburg, J. M. Parker, and C. J. Briggs. 2006. Emerging infectious disease as a proximate cause of amphibian mass mortality. Ecology 87(7):1671-1683.

Rachowicz, L. J., and C. J. Briggs. 2007. Quantifying the disease transmission function: effects of density on *Batrachochytrium dendrobatidis* transmission in the mountain yellow-legged frog *Rana muscosa*. Journal of Animal Ecology 76:711-721.

Ramos CE, MacDonald LH. 2005. Measurement and prediction of sediment production from unpaved roads, St John, US Virgin Islands. Earth Surface Processes and Landforms. 30: 1284-1304.

Raphael, M. G. and M. White. 1984. Use of snags by cavity-nesting birds in the Sierra Nevada. Wildlife Society Monograph No. 86. 66pp.

Rice, R.M. et.al. 2000. Forest Management Effects on Erosion, Sediment, and Runoff: Lessons From Caspar Creek and Northwestern California. Society of Amarican Foresters 2000 National Convention Proceedings. Washington, DE, Nov 16-20, 2000.

Robitaille, J.-F., and K. Aubry. 2000. Occurrence and activity of American martens Martes Americana in relation to roads and other routes. Acta Theriologica 45(1):137-143.

Rowland, M. M., M. J. Wisdom, D. H. Johnson, B. C. Wales, J. P. Copeland, and F. B. Edelmann. 2003. Evaluation of landscape models for wolverines in the interior northwest, United States of America. Journal of Mammalogy 84(1):92-105.

Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, L. J. Lyon and W. J. Zielinski, tech. eds. 1994. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the United States. Gen. Tech. Rep. RM-254. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 184 pp.

Ruggiero, L. F., D. E. Pearson, and S. E. Henry. 1998. Characteristics of American marten den sites in Wyoming. Journal of Wildlife Management 62(2):663-673.

Ruggiero, L. F., K. S. McKelvey, K. B. Aubry, J. P. Copeland, D. H. Pletscher, and M. G. Hornocker. 2007. Wolverine conservation and management. Journal of Wildlife Management 71(7):2145-2146.

Ruth, F. S. 1954. Wolverine seen in Squaw Valley, California. Journal of Mammalogy 35(4):594-595.

Safford, H.D.; Stevens, J.T.; Merriam, K.; Meyer, M.D.; Latimer, A.M. 2012. Fuel treatment effectiveness in California yellow pine and mixed conifer forests. Forest Ecology and Management. 274: 17-28.

Schwartz, M. K., K. B. Aubry, K. S. McKelvey, K. L. Pilgrim, J. P. Copeland, J. R. Squires, R. M. Inman, S. M. Wisely, and L. F. Ruggiero. 2007. Inferring geographic isolation of wolverines in California using historical DNA. Journal of Wildlife Management 71(7):2170-2179.

Seamans, M. E. 2005. Population biology of the California spotted owl in the central Sierra Nevada. Dissertation, University of Minnesota, St. Paul, Minnesota.

Seamans, M.E., AND R.J. Gutie´rrez. 2007. Habitat selection in a changing environment: The relationship between habitat alteration and spotted owl territory occupancy and breeding dispersal. *Condor*. 109:566 –576.

SERA (Syracuse Environmental Research Associates, Inc). 2006. Human Health and Ecological Risk Assessment for Borax (Sporax®) Final Report. Dr. Pat Durkin, Ph.D., Dr. Julie Klotzbach, authors. February 24, 2006. Unpublished. SERA TR 04-43-21/06-30-02b.

Shaman, J.; Stieglitz, M.; Burns, D. 2004. Are big basins just the sum of small catchments? Hydrological Processes. 18: 3195–3206.

Shepperd, Wayne D. et.al. 2006. Ecology, Management, and Restoration of Aspen in the Sierra Nevada Final Report, Collaborative Work Agreement between USDA, Forest Service Lake Tahoe Basin Management Unit and USDA, Forest Service, Rocky Mountain Research Station January 20, 2006.

Sherburne, S. S. and J. A. Bissonette. 1994. Marten subnivean access point use: response to subnivean prey levels. Journal of Wildlife Management 58:400-405.

Simon, Terri Lee. 1980. An ecological study of the marten in the Tahoe National Forest, California. M.S. Thesis, California State University, Sacramento, CA. 187 p.

Singh, V.P. 1997. Effect of spatial and temporal variability in rainfall and watershed characteristics on stream flow hydrograph. Hydrological Processes.11(12): 1649–1669.

Slauson, K. M. 2003. Habitat selection by American martens (Martes Americana) in coastal northwestern California. MS Thesis, Oregon State University, Corvallis, Oregon.

Slauson, K. M., and W. J. Zielinski. 2009. Characteristics of summer and fall diurnal resting habitat used by American martens in coastal northwestern California. Northwest Science 83:35-45.

Slauson, K. M., W. J. Zielinski, and J. P. Hayes. 2007. Habitat selection by American martens in coastal California. Journal of Wildlife Management 71(2):458-468.

Spencer, Wayne Duard. 1981. Pine marten habitat preferences at Sagehen Creek, California. M.S. Thesis, University of California, Berkeley, CA. 121 p.

Spencer, W. D. and W. J. Zielinski. 1983. Predatory behavior of pine martens. Journal of Mammalogy 64:715-717.

Spears et.al. 2003. The influence of decomposing logs on soil biology and nutrient cylcling in old growth mixed coniferous forest in Oregon, U.S.A. Can. J. For. Res. 33: 2193–2201 (2003)

Strahm, Brian D. et.al. 2000. Changes in dissolved organic matter with depth suggest the potential for postharvest organic matter retention to increase subsurface soil carbon pools. Forest ecology and management. Vol. 258, no. 10 (Oct. 30, 2009): p. 2347-2352.

Steger, G. N., T. E. Munton, G. P. Eberlein and K. D. Johnson. 1998. A study of spotted owl demographics in the Sierra National Forest and Sequoia and Kings Canyon National Parks. USDA Forest Service, Pacific Southwest Research Station, Fresno, CA. Annual Progress Report, November 1998. 5pp.

Steger, G. N., T. E. Munton, G. P. Eberlein and K. D. Johnson. 1999. A study of spotted owl demographics in the Sierra National Forest and Sequoia and Kings Canyon National Parks. USDA Forest Service, Pacific Southwest Research Station, Fresno, CA. Annual Progress Report, December 1999. 16pp.

Stephens, S. 2001. Fire history differences in adjacent Jeffry pine and upper montane forests in the eastern Sierra Nevada. International Journal of Wildland Fire 10, 161-167.

Stephens, S.L., Martin, R.E, Clinton, N.E. 2007. Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. For. Ecol. Manage., 251, pp. 205–216

Sugihara et al., 2006N.G. Sugihara, J.W. van Wagtendonk, K.E. Shaffer, J. Fites-Kaufman, A.E. Thode. 2006. Fire in California's ecosystems. University of California Press, Berkeley, CA.

Taylor, D. W. 1981. Freshwater Mollusks of California: A Distributional Checklist. California Department of Fish and Game 67(3):140-163.

Taylor, A.H. 2004. Identifying Forest Reference Conditions on Early Cut-Over Lands, Lake Tahoe Basin, USA. Ecological Applications 14(6). pp 1903-1920.

Thomas, Jack W. 1979. Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington. USDA Forest Service Ag. Handbook No. 553.

Thomas, J. W., E. E. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. A Conservation Strategy for the Northern Spotted Owl. Washington, DC, U.S. Government Printing Office, 427 pp.

USDA Forest Service 1987. Forest position statement Siskiyou National Forest. Forest management team notes of May 27, 1987. (unpublished report on file at Grants Pass, Oregon).

USDA Forest Service. Region 5. 1988. Soil and Water Conservation Handbook, Chapter 20 Cumulative Off-Site Watershed Effects Analysis.

USDA Forest Service 1990. Soil erosion hazard rating. Soil and Water Conservation Handbook, CH.50, R-5 FSH2509.22, R5 Amend. 2. PSW Region, Vallejo, California.

USDA Forest Service. 1990. Tahoe National Forest Land and Resource Management Plan. Nevada City, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Tahoe National Forest.

USDA Forest Service. 1991. Management recommendations for the northern goshawk in the southwestern United States. Northern Goshawk Scientific Committee. Southwestern Region. 184 pp.

USDA Forest Service. 1993. California Spotted Owl Sierran Province Interim Guidelines Environmental Assessment. 87pp.

USDA Forest Service. 1991. Protocol for surveying for spotted owls in proposed management activity areas and habitat conservation areas. 19 pp.

USDA Forest Service. 1994. Soil Survey, Tahoe National Forest Area California. Pacific Southwest Region, USDA Forest Service, USDA Soil Conservation Service and Regents of the UC Agricultural Experiment Station.

USDA Forest Service, 1994. Soil Survey, Tahoe National Forest Area California. Pacific Southwest Region, USDA Forest Service in cooperation with USDA Soil Conservation Service and Regents of the UC Agricultural Experiment Station.

USDA Forest Service. 1999. Eight Eastside Rivers Wild and Scenic River Study Report and Final Environmental Impact Statement Record of Decision. Nevada City, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Tahoe National Forest and Lake Tahoe Basin Management Unit.

USDA Forest Service. 1999. New information and management considerations for the northern goshawk (*Accipter gentilis*). Tahoe National Forest, Nevada City, CA. 16 pp.

USDA Forest Service. 2000. Survey Protocol for the Northern Goshawk in the Pacific Southwest Region.

USDA Forest Service, 2001, Water Quality Protection on National Forests in the Pacific Southwest Region: Best Management Practices Evaluation Program, 2003-2007. Pacific Southwest Region, Vallejo, California.

USDA Forest Service. 2003. Sierra Nevada Forest Plan Amendment: Management Review and Recommendations. R5-MB-012. March 2003. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Vallejo, California.

USDA Forest Service Pacific Southwest Region. 2004. Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement Record of Decision. Region 5, Vallejo, CA.

USDA Forest Service PSWR 2009. Water Quality Protection on National Forests in the Pacific Southwest Region: Best Management Practices Evaluation Program, 2003-2007. Pacific Southwest Region, Vallejo, California.

USDA Forest Service. 2009. California spotted owl module: 2008 annual report (on the Plumas-Lassen study). Keane, J.J. (Principal Investigator), C.V. Gallagher, R.A. Gerrard, G. Jehle, and P.A. Shaklee. USDA Forest Service Pacific Southwest Research Station, Davis, California. 36 pp.

USDA Forest Service. 2012. Transition Project Water Resources Cumulative Watershed Effects Analyses. Sierraville Ranger District, Tahoe National Forest. Unpublished Project Record.

USDI Fish and Wildlife Service. 1998. Endangered and Threatened Wildlife and Plants; Notice of 12 Month Finding on a Petition To List the Northern Goshawk in the Contiguous United States West of the 100th Meridian. Federal Register 63(124):35183-35184.

USDI Fish and Wildlife Service. 2000. Endangered and Threatened Wildlife and Plants: 90-day Finding on a Petition To List the California Spotted owl as Threatened or Endangered. Federal Register 65(198):60605-60607

USDI Fish and Wildlife Service 2000. Endangered and Threatened Wildlife and Plants: 90-day Finding on a Petition to List Mountain Yellow-legged Frog as Endangered. Federal Register 65(198):60603-60605.

USDI Fish and Wildlife Service. 2002. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Southern California Distinct Vertebrate Population Segment of the Mountain Yellow-Legged Frog (Rana muscosa). Federal Register 67(127):44382-44392.

USDI Fish and Wildlife Service. 2003. Endangered and Threatened Wildlife and Plants: 12-Month Finding for a Petition to List the California Spotted Owl (*Strix occidentalis occidentalis*). Federal Register 68(31):7580-7608.

USDI Fish and Wildlife Service. 2003. Endangered and Threatened Wildlife and Plants; 12-Month Finding for a Petition To List the Sierra Nevada Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*). Federal Register 68(11):2283-2303.

USDI Fish and Wildlife Service. 2005. Endangered and Threatened Wildlife and Plants: 90-day Finding on a Petition To List the California Spotted owl as Threatened or Endangered. Federal Register 70(118):35607-35613.

USDI Fish and Wildlife Service. 2006. Endangered and Threatened Wildlife and Plants: 12-Month Finding for a Petition to List the California Spotted Owl (*Strix occidentalis occidentalis*). Federal Register 71(100):29886-29906.

USDI Fish and Wildlife Service. 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Southern California Distinct Population Segment of the Mountain Yellow-Legged Frog (*Rana muscosa*). Federal Register 71(127):54344-54386.

USDI Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Sierra Nevada Distinct Population Segment of the Mountain Yellow-Legged Frog (*Rana muscosa*). Federal Register 72(121):34657-34661.

USDI Fish and Wildlife Service. 2007b. Authorizations Under the Bald and Golden Eagle Protection Act for Take of Eagles. Federal Register 72(107):31141-31155.

USDI Fish and Wildlife Service. 2007c. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife. Federal Register 72(130):37345-37372.

USDI Fish and Wildlife Service. 2007d. Endangered and Threatened Wildlife and Plants; Draft Post Delisting Monitoring Plan for the Bald Eagle (*Haliaeetus leucocephalus*) and Proposed Information Collection. Federal Register 72(130):37373-37374.

USDI Fish and Wildlife Service. 2008a. Endangered and Threatened Wildlife and Plants; Listing the Potential Sonoran Desert Bald Eagle Distinct Population Segment as Threatened Under the Endangered Species Act. Federal Register 73(85):23966-23970.

USDI Fish and Wildlife Service. 2008b. Authorizations Under the Bald and Golden Eagle Protection Act for Take of Eagles. Federal Register 73(98):29075-29084.

USDI Fish and Wildlife Service. 2008c. Endangered and Threatened Wildlife and Plants; Initiation of Status Review for the Bald Eagle (*Haliaeetus leucocephalus*) in the Sonoran Desert Area of Central Arizona and Northwestern Mexico. Federal Register 73(98):29096-29098.

USDI Fish and Wildlife Service. 2008d. Eagle Permits; Take Necessary To Protect Interests in a Particular Locality. Federal Register 73(158):47574-47577.

USDI Fish and Wildlife Service. 2009a. Endangered and Threatened Wildlife and Plants; Status Review of the Bald Eagle (*Haliaeetus leucocephalus*) in the Sonoran Desert Area of Central Arizona and Northwestern Mexico. Federal Register 74(10):2465-2467.

USDI Fish and Wildlife Service. 2009b. Eagle Permits; Take Necessary To Protect Interests in Particular Localities. Federal Register 74(175):46836-46879.

USDI Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States. Proposed Rule. [FWS-R6-ES-2012-0107: 4500030113]. http://federalregister.gov/a/2013-01478

Van de Water and Safford, 2011K.M. Van de Water, H.D. Safford. 2011. A summary of fire frequency estimates for California vegetation before Euroamerican settlement. Fire Ecol. http://dx.doi.org/10.4996/fireecology.

Verner, J. and A.S. Boss, technical coordinators. 1980. California wildlife and their habitats: Western Sierra Nevada. USDA Forest Service, PSW-37., Berkeley, CA. 439 pp.

Verner, J. 1999. Review of "A preliminary report on the status of the California spotted owl in the Sierra Nevada." Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Fresno, CA. July 7, 1999. 9pp.

Verner, J., K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck. 1992a. Assessment of the current status of the California spotted owl, with recommendations for management. Pp 3-26 *in* J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck (technical coordinators); The California spotted owl: a technical assessment of its current status. Gen. Tech. Rep. PSW-GTR-133. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Verner, J., K. S., R. J. Gutiérrez, and G. I. Gould, Jr. 1992b. The California spotted owl: General biology and ecological relations. Pp 55-77 *in* J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck (technical coordinators); The California spotted owl: a technical assessment of its current status. Gen. Tech. Rep. PSW-GTR-133. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Vindum, J. V., M. M. Tierney, and M. S. Koo. 1997. 1997 Amphibian and reptile surveys in the Tahoe National Forest: the result of CCSA-05-97-17-024. Department of Herpetology, California Academy of Sciences, San Francisco, California.

Vindum, J. V., and M. S. Koo. 1999a. 1998 Amphibian and reptile surveys in the Plumas and Tahoe National Forests: the result of CCSA-05-98-17-123. Department of Herpetology, California Academy of Sciences, San Francisco, California.

Vindum, J. V., and M. S. Koo. 1999b. Amphibians and reptiles of the Tahoe National Forest: historical collections and results of 1997-1999 California Academy of Sciences surveys. Department of Herpetology, California Academy of Sciences, San Francisco, California.

Voyles, J., S. Young, L. Berger, C. Campbell, W. F. Voyles, A. Dinudom, D. Cook, R. Webb, R. A. Alford, L. F. Skerratt, and R. Speare. 2009. Pathogenesis of chytridiomycosis, a cause of catastrophic amphibian declines. Science 326:582-585.

Vredenburg, V.T. 2004. Reversing introduced species effects: experimental removal of introduced fish leads to rapid recovery of a declining frog. Proceedings of the Natural Academy of Sciences 101(20):7646-7650.

Vredenburg, V., G. M. Fellers, and C. Davidson. 2005. The mountain yellow-legged frog Rana muscosa (Camp 1917). Pp. 563-566 *In* M. Lannoo (Editor); Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley, California.

Vredenburg, V. T., R. Bingham, R. Knapp, J. A. T. Morgan, C. Moritz, D. Wake. 2007. Concordant molecular and phenotypic data delineate new taxonomy and conservation priorities for the endangered mountain yellow-legged frog. Journal of Zoology 271: 361-374.

Wake, D. B., and V. T. Vredenburg. 2008. Are we in the midst of the sixth mass extinction? A view from the world of amphibians. Proceedings of the National Academy of Sciences 105(Suppl. 1):11466-11473.

Wemple BC, Jones JA, Grant GE. 1996. Channel network extension by logging roads in two basins, western Cascades, Oregon. Water Resources Bulletin. 32: 1195-1207.

Weixelman, D. A. and D. J. Cooper, 2009. Assessing Proper Functioning Condition for Fen Areas in the Sierra Nevada and Southern Cascade Ranges in California, A User Guide. Gen. Tech. Report. R5-TP-028. Vallejo, CA. Department of Agriculture , Forest Service, Pacific Southwest Region. 42p.

Williams, D. F., J. Verner, H. F. Sakai, and J. R. Waters. 1992. General biology of major prey species of the California spotted owl. Pp 207-221 *in* J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck (technical coordinators); The California spotted owl: a technical assessment of

its current status. Gen. Tech. Rep. PSW-GTR-133. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Williams, D. F., R. J. Gutierrez and S. Whitmore. 2011. Home range and habitat selection of spotted owls in the central Sierra Nevada. Journal of Wildlife Management **75**:333-343

Wilson, Dick. 1992. Sawdust trails in the Truckee Basin: a history of lumbering operations. Nevada County Historical Society, Nevada City, CA.

Wilson, J. 1981. Some aspects of the ecology of the great gray owl in the Central Sierra Nevada. USDA Forest Service. 30pp.

Wilson, J. 1985. Great gray owl survey, 1984. California Department of Fish and Game. Project W-65-R 2. Progress Report.

Winter, J. 1981. Some aspects of the ecology of the great gray owl in the Central Sierra Nevada. USDA, Forest Service. Stanislaus National Forest Contract # 43-2276. Final report. Sonora, CA. 30pp.

Winter, J. 1982. Further investigations on the ecology of the great gray owl in the central Sierra Nevada. Final Report to the Forest Service under contract #43-2348. Stanislaus National Forest, Sonora CA. 35pp.

Winter, J. 1986. Status, distribution and ecology of the great gray owl (*Strix nebulosa*) in California. San Francisco, CA: San Francisco State University. 121pp. M.S. thesis.

Woodhams, D. C., R. A. Alford, and G. Marantelli. 2003. Emerging disease of amphibians cured by elevated body temperature. Diseases of Aquatic Organisms 55:65-67.

Woodhams, D. C., K. Ardipradja, R. A. Alford, G. Marantelli, L. K. Reinert, and L. A. Rollins-Smith. 2007. Resistance to chytridiomycosis varies among amphibian species and is correlated with skin peptide defenses. Animal Conservation 10:409-417.

Zabel, C. J., G. N. Steger, K. S. McKelvey, G. P. Eberlein, B. R. Noon, and J. Verner. 1992. Home-range size and habitat-use patterns of California spotted owls in the Sierra Nevada. Pp 149-163 *in* J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. Gould, Jr., and T. W. Beck (technical coordinators); The California spotted owl: a technical assessment of its current status. Gen. Tech. Rep. PSW-GTR-133. U. S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, California.

Zabel, C. J., K. McKelvey, and J. P. Ward, Jr. 1995. Influence of primary prey on home-range size and habitat-use patterns of northern spotted owls (*Strix occidentalis caurina*). Canadian Journal of Zoology 73: 433-439.

Zielinski, William James. 1981. Food habits, activity patterns and ectoparasites of the pine marten at Sagehen Creek, California. M.S. Thesis, University of California, Berkeley, CA. 121 p.

Zielinski, W. J. 2013. The Forest Carnivores: Fisher and Marten. Chapter 7.1, pages 1-40 in Long, Jonathan; Skinner, Carl; North, Malcolm; Winter, Pat; Zielinski, Bill; Hunsaker, Carolyn; Collins, Brandon; Keane, John; Lake, Frank; Wright, Jessica; Moghaddas, Emily; Jardine, Angela; Hubbert, Ken; Pope, Karen; Bytnerowicz, Andrzej; Fenn, Mark; Busse, Matt; Charnley, Susan; Patterson, Trista; Quinn Davidson, Lenya; Safford, Hugh; chapter authors and Synthesis team members. USDA Forest Service Pacific Southwest Research Station. 2013. Science Synthesis to support Forest Plan Revision in the Sierra Nevada and Southern Cascades. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 504 p.

Zielinski, W. J., W. D. Spencer and R. H. Barrett. 1983. Relationship between food habits and activity patterns of pine martens. Journal of Mammalogy 64:387-396.

Zielinski, W. J., T. E. Kucera, and R. H. Barrett. 1995. Current distribution of fishers, *Martes pennanti*, in California. California Fish and Game 81, 104-112.

Zielinski, W. J., and R. T. Golightly. 1996. The status of marten in redwoods: is the Humboldt marten extinct? Pp. 115-119 in J. LeBlanc, ed. Conference on Coast Redwood Forest Ecology and Management. Humboldt State University, Arcata, California.

Zielinski, W. J., R. H. Barrett, and R. L. Truex. 1997. Southern Sierra Nevada fishers and marten study: Progress Report IV. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, California. 37 pp.

Zeiner, D.C., W.F. Laudenslayer, Jr., K. E. Mayer, and M. White. 1988. California's Wildlife. Volume I. Amphibians and Reptiles. California Statewide Wildlife Habitat Relationships System. Department of Fish and Game, The Resources Agency, Sacramento, CA. 272 pages.