Modified Timber Harvesting Plans for Fuel Reduction and Large Scale Wildlife Impact Analysis

How will implementation of a Modified THP for fuel reduction and associated change in forest conditions influence terrestrial wildlife species habitat capability?

We used the California Wildlife Habitat Relationships System (CWHR) to examine change in forest conditions. Four forest types were selected that were consistent with prior fire behavior modeling (Leddy 2010): Douglas fir, white fir, Sierran mixed conifer and ponderosa pine. Proposed rule language concerning the minimum overstory tree canopy (40%) to be left post treatment and restrictions on the treatment of “old-growth” stands limited the number of structure change scenarios to 4 for each of the 4 forest types (a total of 16 CWHR queries). Each scenario is defined as follows:

1) Heterogeneous sized stand beginning as 4D (CWHR defined as 11-24 inch dbh trees with 60-100% canopy closure) is thinned from below resulting in an increase in quadratic mean diameter and reduction in canopy closure to 40% or a 5M stand (CWHR defined as trees greater than 24 inches dbh with 40-59% canopy closure).

2) Homogeneous sized stand beginning as 4D is thinned resulting in a reduction in canopy closure to 40% or a 4M stand (CWHR defined as 11-24 inch dbh trees with 40-59% canopy closure).

3) Heterogeneous sized stand beginning as 5D (CWHR defined as trees greater than 24 inches dbh with 60-100% canopy closure) is thinned/portion of overstory removed resulting in a decrease in quadratic mean diameter and reduction in canopy closure or a 4M stand.

4) Homogeneous sized stand beginning as 5D is thinned resulting in a reduction in canopy closure to 40% or a 5M stand.

A two-condition habitat comparison model with arithmetic mean was used to generate an affected species list. In this comparison, one or more life requisites that are <u>not</u> met (reproduction, feeding, or cover) does not deem the habitat to be unsuitable since values for each life requisite are added and then averaged. All life requisites were modeled at a low suitability rank. This suitability rank maximized the number of species potentially making use of the stand to those that are supported at relatively low or higher population densities.

Pre treatment fuel accumulations (slash, downed woody debris, fuel ladder conditions etc) are assumed to be removed as part of each of the 4 management scenarios described above. Stephens and Moghaddas (2005a) note that fundamental elements of any fuel treatment include reducing surface fuel loads, not substantially increasing surface fuel loads by adding activity fuels and adequately raising height to crown base to reduce passive crown fire. Solely reducing crown bulk density with crown thinning alone does not substantially change potential fire behavior or effects. Fuel accumulation treatment was simulated by excluding certain special habitat elements (Layer shrub; Layer tree; All logs rotten, sound or hollow; All slash rotten, sound or hollow; All snags rotten or sound and Tree/Shrub Interface). Elements were excluded at the Secondarily Essential level meaning that it was an element that must be present within the home range of the species for the species to be present unless it is compensated by the presence of another secondarily essential element that serves the same function to the species.

Results

Modeled change in habitat capability for the Sierran mixed conifer type and ponderosa pine type as “dry” forest types and Douglas-fir as a “mesic” forest type are reported below. Percent change in habitat capability likely represents a worse case condition since it is unlikely that all special habitat elements would be removed under a MTHP for fuel reduction. However this worse case modeling condition becomes increasingly likely as fuel load maintenance efforts are conducted into the future to maintain initial treatment effectiveness.

Sierran Mixed Conifer

In general, percent change in habitat capability for each of the forest types and *across* each of the 4 scenarios described above changed little, varying by only one to two percent for each of the species classes. However, *within* a forest type and using Sierran mixed conifer as an example, habitat capability was lost for 55 percent of the 185 species occurring (Scenario 3 above). Conversely, habitat capability was created, increased or remained the same for 45 percent of the species expected to occur.

Of the 50 special status wildlife species (excusive of “Harvest” species” occurring under Scenario 3 and modeled by the California Wildlife Habitat Relationships System), 22 or 44 percent lost all habitat capability, 27 or 54 percent either had habitat created, increase or remain unchanged (e.g. Scenario 3 SMC 5D to 4M habitat elements excluded as part of query design).

Exclusion of special habitat elements typically managed under a MTHP for fuel reduction can have a marked effect on species habitat capability (see details in the question below). For example, when special habitat elements were retained under Scenario 3 and in contrast to the results reported above, no species lost habitat capability and only 10 percent exhibited a decrease. Habitat capability was created, increased or remained unchanged for 90 percent of the species within the Sierran mixed conifer forest type (e.g. Scenario 3 SMC 5D to 4M--only forest canopy/size class change is modeled).

Ponderosa Pine

Within the ponderosa pine forest type, habitat capability was lost for 52 percent of the 177 species occurring (Scenario 3 above). Conversely, habitat capability was created, increased or remained the same for 44 percent of the species expected to occur.

Of the 50 special status wildlife species (excusive of “Harvest” species” occurring under Scenario 3 and modeled by the California Wildlife Habitat Relationships System), 21 or 42 percent lost all habitat capability, 28 or 56 percent either had habitat created, increase or remain unchanged (e.g. Scenario 3 PPN 5D to 4M habitat elements excluded as part of query design).

When special habitat elements were retained for this forest type, results were very similar to those for the Sierran mixed conifer type and again illustrate the influence of special habitat element presence on habitat capability. For example, when special habitat elements were retained under Scenario 3 and in contrast to the results reported above, no species lost habitat capability and only 20 or 10 percent exhibited a decrease. Habitat capability was created, increased or remained unchanged for 89 percent of the species within the ponderosa pine forest type (e.g. Scenario 3 PPN 5D to 4M--only forest canopy/size class change is modeled).

Douglas Fir

Within the Douglas fir habitat type, habitat capability was lost for 57 percent of the 160 species occurring (Scenario 3 above). Conversely, habitat capability was created, increased or remained the same for 40 percent of the species expected to occur.

Of the 44 special status wildlife species (excusive of “Harvest” species” occurring under Scenario 3 and modeled by the California Wildlife Habitat Relationships System), 21 or 48 percent lost all habitat capability, 22 or 50 percent either had habitat created, increase or remain unchanged (e.g. Scenario 3 PPN 5D to 4M habitat elements excluded as part of query design).

When special habitat elements were retained for this forest type, results were slightly different from those for the dry forest types but again illustrate the influence of special habitat element presence on habitat capability. For example, when special habitat elements were retained under Scenario 3 and in contrast to the results reported above, 5 species lost habitat capability and only 22 species or 13 percent exhibited a decrease. Habitat capability was created, increased or remained unchanged for 85 percent of the species within the Douglas fir forest type (e.g. Scenario 3 PPN 5D to 4M--only forest canopy/size class change is modeled).

How will the absence of certain special habitat elements on implementation of a fuel reduction project influence species composition and habitat capability?

Trees, shrubs and forest debris are the intended targets of fuel reduction projects to reduce ladder fuels, and increase crown spacing thereby reducing the potential for fire to spread and reducing its intensity. Yet, habitat elements such as sub-canopy trees, snags, downed logs, etc. are critical for a wide variety of wildlife, including species with special conservation status. All wildlife have three basic needs from a particular habitat; food, shelter and a place to raise young protected from predators. A heterogeneous forest includes a variety of tree species and includes elements that provide these life requisites. For example, food resources such as acorns from hardwoods provide a forage resource that sustains a wide range of wildlife species. Other structural elements, such as large diameter snags, down logs, and trees with cavities provide unique nesting and denning sites often lacking in the forest landscape. Slash can provide cover as well. Ensuring that elements which provide food and cover for wildlife are retained in the landscape is an important objective of fuel reduction projects. Without this consideration, habitat losses will accumulate for a wide variety of species, including several holding special conservation status.

Determining the ideal number of retained habitat elements and their spatial arrangement is frequently challenging. From a regulatory standpoint, establishing enforceable standards for forest diversity proves challenging given the variety of distinct forest types and structural elements found in California. Where certain forests may be limited in hardwoods, others may be lacking large snags or deformed trees. The CWHR model was queried to isolate key forest habitat elements and determine the percent habitat gained or lost for a suite of species occurring in a particular forest type. Limitations of the model (coarse scale, simplified matrix) precluded the ability to draw specific conclusions; only general trends of species affected by a particular forest treatment or exclusion of habitat elements. The results provide insight as to the relative importance of these elements.

Results

Special habitat elements are specific physical and biological attributes of the landscape (snags, ponds etc) without which, certain species are not expected to be present, or if present, are at relatively low population numbers. CWHR was used to examine the change in terrestrial wildlife species' habitat availability upon implementation of the proposed Modified THP for Fuel Hazard Reduction Forest Practice Rule and expected change in forest structure. In this section, six habitat elements were each individually excluded in a mature forest stand (WHR 5M defined as 11-24 inch dbh trees with 60-100% canopy closure) to determine potential impacts to wildlife. The habitat elements include:

- ☐ Snags, Rotten and Sound (greater than 30 inches DBH)
- ☐ Down logs, Hollow, Rotten and Sound (greater than 20 inches in diameter)
- ☐ Subdominant tree layer (greater than 10% subcanopy trees) <u>and</u> the tree/shrub interface
- ☐ Hardwood trees and acorns
- ☐ Trees with cavities
- ☐ Slash, Hollow, Rotten and Sound (residue 3 – 10 inches in diameter)

A CWHR model was constructed based on the three life requisites reproduction, forage and cover. Four forest types were selected to be consistent with prior fire behavior modeling (Leddy 2010): Douglas fir, white fir, Sierra mixed conifer and Ponderosa pine. A forest structure 5M classification was used as a template to facilitate comparing habitat gains/losses when a particular habitat element was excluded.

A two-condition habitat comparison model with arithmetic mean was used to generate an affected species list with an associated percentage of habitat gained/lost when an individual habitat element was excluded. In this comparison, one or more life requisites that are <u>not</u> met (reproduction, feeding, or cover) does not necessarily deem the habitat to be unsuitable, rather it is characterized by low suitability. All life requisites were modeled at a low suitability rank. This suitability rank was used to encompass all types of habitat suitability, including those habitats which would support low population densities.

Pre- treatment fuel accumulations (slash, downed woody debris, certain layered canopy conditions etc) will remove these habitat elements. Fuel treatment was simulated by excluding habitat elements individually. Elements were excluded at the Essential level, with the exception of the Reproduction life requisite, meaning that if the species used that element and the element was removed, then the species would not be present in post treatment stand. The Reproduction life requisite was modeled at the Secondarily Essential level, defined as a required element but potentially compensated by the presence of other secondarily essential elements in the same life requisite category.

Excluding any of the habitat elements resulted in habitat loss in all habitat types. Virtually no habitat was created by removing these critical components. The greatest loss of habitat capability occurred when the sub-canopy tree layer and the tree/shrub interface (simulating the fuel treatment) was removed. An average of 41% habitat loss resulted from this forest treatment. Trees with cavities, hardwoods with acorns and large snags when removed also resulted in marked habitat loss (Table 1).

Table 1: CWHR Model of Habitat Capability Created or Lost Through Element Exclusion

All Species Habitat Capability		Large Rotten and Sound Snags	Tree Layer > 10%; Tree/Shrub Interface	Large Rotten and Sound Logs	Trees With Cavities	Hardwood and Acorns	Slash, large (Hollow, Rotten and Sound
Percentage of Species with Habitat Created	**All forest types**	0	0	0	0	0	0
Percentage of Species with Habitat Lost	**Douglas Fir**	14	43	6	19	11	3
Percentage of Species with Habitat Lost	**Ponderosa Pine**	17	40	7	19	12	3
Percentage of Species with Habitat Lost	**White Fir**	15	41	7	19	9	3
Percentage of Species with Habitat Lost	**Sierran Mixed Conifer**	15	40	6	18	10	4

The results demonstrate that significant habitat loss can be expected when fuel treatments eliminate ladder fuels and sub-canopy trees and other habitat elements from a project area. Similarly, specific habitat elements such as large snags and downed wood provide structure for nests and dens, cover and food resources. Although a highly variable and transitory resource, the number of large snags and large downed logs is typically below desired densities when viewed at the scale of a forested landscape (Richter 1993). Larger diameter snags and down logs are considered to be the most valuable because of the disturbance (intense fire, insect attack etc.) free time period required to replace them. Live trees with cavities are also primary reproductive structures for cavity nesting/denning species. These trees frequently exhibit low vigor and an increased potential for torching and would generally be selected for removal.

To minimize the potential for habitat loss, the type and minimum density of key habitat elements to retain is outlined in Section (11) of the Modified THP plead. These protection measures are being established to acknowledge their importance and ensure their retention in the forest landscape. They require retention of the following elements, if present, prior to operations:

- ☐ A minimum of 2 large live cull (green) conifer trees 24” dbh and larger per acre;
- ☐ A minimum of two hardwood trees 24” dbh and larger per acre;
- ☐ A minimum of two downed logs 20” dbh and larger per acre;
- ☐ 2% of every 20 acres to be treated under the MTHP shall be left as untreated habitat retention surrounding or in direct proximity to the habitat elements identified in 1, 2, and 3 above.

As an alternative to compliance with (11), a performance based approach is described to encourage forest landowners to proactively manage vegetation to create fire resilient conditions, and reduce the threat, and potentially deleterious effects of unmanaged fire (Appendix A). Implementation of these performance standards are expected to result in project or landscape scale area conditions that reduce the effect of measures typically associated with unmanaged fire but that also protect biological resource values at the project or landscape scale.

It is the intent of the performance based approach to identify specific performance areas for various aspects of forest fuel management and effects on biological resources that will ultimately better assure relevance to California’s institutional priorities and departmental missions, be more responsive to stakeholder and landowner needs, and identify more opportunities to partner with other private landowners as well as federal, state and local entities.

What is the modeled effect of severe wildfire on species occurrence and habitat capability versus fuel treatment?

The spatial pattern of fuel treatment across a landscape will likely determine its effectiveness at modifying fire behavior and severity. Fire behavior under extreme fire weather typically involves large areas of fuels, multiple fires and a rapidly moving fire front. Therefore, hundreds to thousands of acres of strategically placed fuel treatments are necessary to meet change in fire behavior and severity objectives. "Treating small or isolated stands without assessing the broader landscape will most likely be ineffective in reducing wildfire extent and severity" (Graham et al 2010 p. 53). Random fuel treatment arrangements are extremely inefficient in changing fire behavior (Finney 2003).

While change in habitat capability can be predicted for terrestrial wildlife species with thinning for fuel reduction at the scale of a project, it is important to weigh those impacts against a no treatment option. Thinning as a silvicultural tool and depending on method of disposal of woody material selected can result in an increase in surface fuels. We use the treatment option phrase "thinning for fuel reduction" to describe the final desired fire resilient forest structural condition of reduced surface and ladder fuels and a reduced crown density. The impacts of a no treatment option in dry forest ecosystems, like those occurring in the Sierra Nevada, must necessarily include the probability of stand-replacing, intense fire as a result of increased stand density and dead fuel accumulations. Agee and Skinner (2005) note that "It may be quite difficult to point to a particular stand and define its probability of burning in some given future period, but the probability that substantial areas of dry forest will continue to be burned by severe wildfire is known, and it is high." The level of forest resilience to severe wildfire resulting from fuel treatment depends not only on the type of treatment but also its scale and juxtaposition to other forest conditions. The landscape scale challenge is to define how much of a landscape needs to be treated, and where strategic fuel treatments will be most effective at reducing wildfire damage.

We examined the change in habitat capability for wildlife inhabiting low to middle-elevation coniferous forest in the Sierra Nevada (Sierran mixed conifer, ponderosa pine) after sustained active crown fire and a stand replacing fire event. Weatherspoon and Skinner (1996) note that these forests types 1) rank at or near the top among Sierran vegetation zones in terms of overall richness and diversity of resources and values; 2) twentieth-century fire occurrence has been much greater than in high-elevation forests; 3) the negative effects of severe wildfire are generally more profound and long-lasting than in other non-coniferous forest types; and 4) the composition and structure of the dominant vegetation in low- to middle-elevation coniferous forests probably have been affected more adversely by removal of the natural fire regime than other vegetation types.

A two-condition habitat comparison model with arithmetic mean was used to generate an affected species list within the Sierran mixed conifer and ponderosa pine forest types upon a severe stand replacing fire originally exhibiting a 5D structure (CWHR defined as trees greater than 24 inches dbh with 60-100% canopy closure). Two potential outcomes relative to habitat type were modeled within the CWHR system during the first decade post fire and included change in forest type to montane chaparral (MCP) 3D (mature shrubs of dense ground cover 60-100%) **or** maintenance of forest type but change in structure to 2M (sapling tree of 1-6 inches dbh with 40-59% canopy or ground cover closure). All life requisites were modeled at the default (Low) suitability rank. This suitability rank did not restrict the number of species potentially making use of the stand if habitat types could be used for breeding, feeding or cover. Special habitat elements not expected to survive the fire event were excluded from the post fire condition and included (acorns, brush pile duff, shrub understory, subcanopy tree layer, litter residue, all logs either rotten, hollow or sound, riparian inclusion, all slash either rotten hollow or sound, all rotten snags of small, medium or large size (sound snags while likely lost in the fire event would also be created as a result of the fire event), stump-rotten, tree leaves, all tree interfaces with other types—e.g. agriculture, grass, shrub, water as well as hardwood, fir or pine trees greater than 11 inches dbh). Elements were excluded at the Secondarily Essential level meaning that an element must be present within the home range of the species for the species to be present unless it is compensated by the presence of another secondarily essential element that serves the same function to the species.

Results

As expected, marked changed in species habitat capability and species richness occur as a result of the modeled wildfire effects for both low to mid elevation dry forest types examined. Within the Sierran Mixed Conifer type where wildfire resulted in maintenance of the type but change in forest structure (5D to 2M), habitat capability was reduced to zero for nearly 80 percent of the species occurring in the pre fire condition (145 of 182 species). Habitat value was created, increased or was unchanged for approximately 18 percent of the species occurring. When viewed by taxonomic group, amphibians and birds occurring in the pre fire condition were most negatively influenced with approximately 92 percent of each taxonomic class experiencing at least a short term loss of 100 percent of habitat capability. Modeled results for mammals showed that 69 percent of these species and 27 percent of reptiles exhibited at least a short term loss of 100 percent of habitat capability.

These results were essentially mirrored when the Sierran Mixed Conifer type was converted to montane chaparral (SMC 5D to MCP 3D). This conversion and duration is driven by site conditions but is generally achieved within 7 to 9 years of the wildfire event (Mayer and Laudenslayer 1988).

Within the ponderosa pine forest type where wildfire resulted in maintenance of the type but change in forest structure (5D to 2M), habitat capability was reduced to zero for 78 percent of the species occurring in the pre fire condition (133 of 171 species). Habitat value was created, increased or was unchanged for approximately 18 percent of the species occurring. When viewed by taxonomic group amphibians and birds occurring in the pre fire condition were most negatively influenced with approximately 92 percent of each taxonomic class, experiencing at least a short term loss of 100 percent of habitat capability. Modeled results for mammals showed that 67 percent of these species and 24 percent of reptiles exhibited at least a short term loss of 100 percent of habitat capability. These modeled results are also duplicated when the ponderosa pine type was converted to montane chaparral (PPN 5D to MCP 3D).

A Performance Based Approach to Accommodating Biological Values on Development of a Modified Timber Harvesting Plan for Fuel Hazard Reduction

As an alternative to a prescriptive treatment of biological resource values, the following performance based approaches are offered to encourage forest landowners to proactively manage vegetation to create fire resilient conditions, and reduce the threat, and potentially deleterious effects of unmanaged fire. Implementation of these performance standards are expected to result in project or landscape scale area conditions that reduce the effect of measures typically associated with unmanaged fire but that also protect biological resource values at the project or landscape scale.

It is the intent of the performance based approach to identify specific performance areas for various aspects of forest fuel management and effects on biological resources that will ultimately better assure relevance to California’s institutional priorities and departmental missions, be more responsive to stakeholder and landowner needs, and identify more opportunities to partner with other private landowners as well as federal, state and local entities.

Principles

A fuel management strategy is desired that addresses short-term fuel treatment objectives and incorporates longer-term and larger scale biological diversity and habitat protection objectives. Fire and fuels management research increasingly supports the general findings that:

> Thinning may not be an effective substitute for fire in affecting ecosystem processes. Reducing surface fuels is as important as reducing ladder fuels, fundamental elements of any fuel treatment include reducing surface fuel loads, not substantially increasing surface fuel loads by adding activity fuels and adequately raising height to crown base to reduce passive crown fire. Solely reducing crown bulk density with crown thinning alone does not substantially change potential fire behavior or effects

"Average" stand conditions are rare in active-fire forests because the interaction of fuels and stochastic fire behavior produced highly heterogeneous forest conditions. Creating "average" stand characteristics replicated hundreds of times over a watershed will not produce a resilient forest, nor one that provides for biodiversity.

Topography and slope position may provide a useful guide for varying treatments and maintenance of biological diversity. Within stands, important stand topographic features include concave sinks, cold air drainages, and moist microsites.

Tree diameter distributions in active- fire forests vary but often have nearly equal numbers in all diameter size classes because of periodic episodes of fire-induced mortality and subsequent recruitment.

The spatial pattern of fuel treatment across a landscape will likely determine its effectiveness at modifying fire behavior and severity. Treating small or isolated stands without assessing the broader landscape will most likely be ineffective in reducing wildfire extent and severity. Random fuel treatment arrangements are extremely inefficient in changing fire behavior.

Criteria and Indicators

I Maintenance of biological diversity and ecological functions

A. Provide measures designed for the protection of key wildlife habitat or habitat elements at the project and landscape (e.g. watershed) scale. Negative effects identified at the project scale may translate to positive effects when larger scale ecosystem drivers such as fire at the scale of the landscape are assessed. Habitats and habitat elements may include key winter range or migration routes, late successional stands, hardwood/aspen groves, riparian or wetland areas, snags, large down woody material, or den trees.

B. Identify those ecological process restoration opportunities that the proposed project will achieve. For example, to what degree do reductions in stem density and canopy cover emulate the stand structure produced by local potential fire behavior, varying by a site's slope, aspect, and slope position.

II Planning and monitoring of operations

A. Identify those measures and silvicultural practices proposed to reduce the rate of fire spread, duration and intensity, fuel ignitability, and ignition of tree crowns. Provide for fuel reduction balanced with ecosystem (disturbance regime) restoration, and wildlife habitat objectives.

B. Provide operational procedures to protect key habitats and/or special habitat elements. These include but are not limited to project site layout, firing pattern, line construction etc. Consider the timing of treatments as they relate to the seasonal requirements of wildlife or plant phenology and describe long-term benefits.

C. Assess the degree to which the proposed project will complement current landscape scale fuel treatments (i.e., SPLATs, DFPZs, and WUI defense zones) or support the objectives of the California Fire Plan or similar local planning effort.

D. Provide a means of monitoring the rate and extent of project implementation as well as maintenance requirements over time.

Summary Findings: Modified Timber Harvesting Plans for Fuel Reduction and Large Scale Wildlife Impact Analysis

- Fire records and perimeters from the 1950-2008 period show an average of 320,000 acres burned annually with a range of 31,000 acres in 1968 to a high of 1.3 million acres in 2008. Conifer forestlands have exhibited a large increase in annual acres burned over the last decade, averaging 193,000 acres per year, compared to an average of 48,000 acres per year over the previous 40 years (CDF-FRAP in press). In addition, the level of fire severity is trending upward, particularly in the forest types of the Sierra Nevada (Miller et al 2008; Lutz et al. 2009).
- Change in forest canopy cover and size class of the type envisioned within the MTHP has a relatively minor impact on species habitat capability for the forest types examined.
- Complete removal of those special habitat elements typically addressed within a MTHP as necessary to achieve desired fuel reduction objectives, or resulting from maintenance activities over time, can have a marked negative effect on modeled species habitat capability (40-50 percent of total species affected).
- Impacts to terrestrial wildlife special status species on implementation of a modeled MTHP typically mirrored those modeled for terrestrial wildlife in general when described in terms of the percent of total species affected.
- On an acre for acre comparison, high intensity wildfire with high severity effects resulted in significant increases in species habitat capability loss over that expected from MTHP for fuel reduction implementation. Habitat capability was reduced to zero for nearly 80 percent of the species occurring in the pre fire condition versus early in the first decade post fire. Bird and amphibian species experienced the greatest loss of habitat capability when impacts are addressed by taxonomic class.
- The level of forest resilience to severe wildfire resulting from fuel treatment depends not only on the type of treatment but also its scale and

juxtaposition to other forest conditions. The landscape scale challenge is to define how much of a landscape needs to be treated, and where strategic fuel treatments will be most effective at reducing wildfire damage.

How can potential presence of special status plant or animal species be most efficiently determined for a project area?

To evaluate the potential for individual land management actions to result in a significant impact to special status species, a scoping process is proposed. In those cases where that impact may be significant, appropriate survey and mitigation measures must be implemented. Although individual project circumstances will dictate the procedures to be used to determine degree of project associated impacts, in general, a scoping process followed by surveys and mitigation development, if necessary, will occur. An assessment area that extends beyond the boundaries of the planned activity also may be required for some species. For unlisted species identified as sensitive, evaluation and mitigation practices are likely to vary according to identified need, the current state of species knowledge and through consideration of input provided by other sources.

Pre-Project Scoping

MTHP proponents should engage in a project-specific scoping process to identify those special status species likely to occur in the affected environment of a project area and the potential habitat impact from the activity either individually or cumulatively. A variety of sources of information will typically be consulted and contribute to the planning process. These include the California Natural Diversity Database (http://dfg.ca.gov/biogeodata/cnddb/) for known species occurrence and, the California Wildlife Habitat Relationships System (http://dfg.ca.gov/biogeodata/cwhr/
http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx) as a predictor of expected species occurrence. Previously completed survey and focused species inventory for neighboring projects or other research efforts are also potential sources of useful data regarding the likelihood of species occurrence. Similarly, broad resource assessments and analyses previously conducted, including surveys and cumulative effects assessments from other projects in the same area or watershed are a useful guide to fuel management projects conducted under a MTHP.

Readily Available Tools and Databases Applicable to the Refinement of Scoping Results:

Terrestrial Wildlife

The California Wildlife Action Plan Matrix: Included in the associated Web publication of the California Wildlife Action Plan (http://www.dfg.ca.gov/wildlife/WAP/report.html) is the Wildlife Species Matrix, consisting of all wildlife taxa (species and subspecies) on the California Department of Fish and Game's Special Animals List. This special status species list includes 140 birds, 127 mammals, 102 fishes, 43 reptiles, 40 amphibians, and 365 invertebrates. Of these, 13 birds, 69 mammals, 19 reptiles, 22 amphibians, 46 fish, and 312 invertebrates are endemic to the state; these taxa are indicated in the matrix with an asterisk.

The matrix can be sorted by taxa names and by region. For each taxon, the matrix provides information on Rarity Ranking Status, Habitat Associations, Population Trends, and Range within California. See http://www.dfg.ca.gov/wildlife/WAP/matrix_search.html

Fish Species

Current species-level range maps for fish are available and are accurate at a scale of roughly 1:1,000,000. For more information about this project or to see additional maps visit http://ice.ucdavis.edu/aquadiv/fishcovs/fishmaps.html

Reptiles and Amphibians

This website http://www.californiaherps.com/index.html documents the diverse reptile and amphibian fauna found in the state of California and includes:

- Lists, picture galleries, range maps, and species accounts of all native and introduced California reptiles and amphibians
- Sound recordings, including the calls of most of California's frogs and toads.
- Tips for identifying California reptiles and amphibians
- Current conservation status information

Plants

The CNPS Inventory of Rare and Endangered Plants

This inventory is now published on-line and updated quarterly. http://cnps.site.aplus.net/cgi-bin/inv/inventory.cgi Along with the latest Inventory data from CNPS, the inventory includes a variety of search tools, maps, thumbnail illustrations, and links to additional information.

The CalFlora Database

Calflora http://www.calflora.org/species/index.html is structured as a digital library to fulfill the following objectives:

1. to serve as a repository for information on California wild plants in electronic formats from diverse sources, including public agencies, academic institutions, private organizations, and individuals.

2. to provide this information in readily usable, electronic formats for scientific, conservation, and educational purposes.
3. to serve public information needs related to scientific study, land management, environmental analysis, education, and appreciation of California plant life.
4. to coordinate and integrate efforts towards these objectives undertaken by scientists, public agencies, private organizations, and members of the public.

This basic search form allows a search by family name, common name, scientific name, county, elevation range, growth form, native status, rarity status, weed status, plant community, etc. In addition, the database may be queried to assess wetland status, federal, state and CNPS listing (rare plants).

The Jepson Flora Project

The Jepson Flora Project http://ucjeps.berkeley.edu/jepson_flora_project.html brings together all of the floristic references and data of the Jepson Herbarium. Resources of the Flora Project are directly linked the Consortium of California Herbaria, CalPhotos, the California Native Plant Society, California Exotic Pest Plant Council, USDA-Plants database, and many other external sites. The online component of the Jepson Flora Project provides users with a single interface from which they can find the most comprehensive, scientifically accurate sources of information on the California flora.

Biological Survey Guidance

Surveys conducted for special status animal species, when indicated following pre-project scoping, should be to established protocols, after consultation with federal or state wildlife management agencies as appropriate, or as practices commonly accepted by CAL FIRE and DFG for Timber Harvesting Plan review.

In general these species are listed and may be among those considered Species of Special Concern by the DFG California Natural Diversity Database or otherwise recognized by state or federal endangered species acts. Population density and detectability of the special status species, habitats occupied, and the level of habitat disturbance expected from the land management action guide survey intensity. Current literature and species authorities should be consulted as necessary. Surveys for special status species will include suitable habitat within the proposed project impact area and inquiries regarding occupancy or suitable habitat off-site that may be affected by project implementation. Surveys, irrespective of the state of protocol development, are to be conducted at a time of year that facilitates positive identification and maximizes the likelihood of contact in the field.

Observations of rare, threatened or endangered plants, animals or plant communities will be recorded on Field Survey Forms and copies provided to the DFG California Natural Diversity Database (CNDDB). In general, it is more efficient to evaluate risk to a species by examining impacts to its habitat when that information is available rather than directly counting or modeling population levels over time.

Survey Protocol Examples:

The protocols and guidelines available here are from various sources and are recommended as tested and reviewed methods for their intended purposes. These purposes include determining the presence or support for a negative finding for a particular species or its local status. In some cases, these protocols and guidelines represent what the Department of Fish and Game believes to be the best available methodology for the intended purpose.
http://dfg.ca.gov/wildlife/nongame/survey_monitor.html

How might cumulative effects be efficiently and effectively addressed for a project proposed under the Modified Timber Harvesting Plan for fuel reduction?

A variety of types of cumulative effects are possible when dealing with biological systems. However, there are in general two types that are typically encountered with forest management. Time-crowded effects occur when impacts are so close in time that the effects of one have not dissipated before the next perturbation occurs. The repeated harvesting of forest stands where snags are removed before replacement snags are regenerated is an example of a time-crowded effect. Space-crowded effects can occur when perturbations are so close in space that their effects overlap. This may occur when two or more forestry operations occur in close proximity such that their effects on wildlife populations and communities overlap (Garrison 1991). Cumulative effects then are the combined impact on specified target resources within a specified geographic area and time period. They include the sum of individual impacts and their interactions.

Fuel treatments can be strategically located and designed to alter a fires progression as it burns through a landscape. The cumulative impact of such a treatment on potential fire behavior and burn severity is dependent on extent of land area treated, timing and location of treatment, type of treatment implemented, and importantly, the time required before the live and dead vegetation returns to pretreatment conditions (Graham et al 2010). The positive or negative cumulative effects of a fuel treatment are the environmental consequences of the activity when added to the existing landscape condition and any reasonably foreseeable future activities or disturbances.

Guidelines for an Evaluation of Cumulative Biological Impacts: a Checklist (excerpted from CDF 1994)

Cumulative effects may be assessed in a variety of ways. The following represents one method but is not the only method available. A cumulative effects assessment can be simplified if a sequential process is developed. The process outlined below consists of a number of separate steps at resource identification, assumption building, data gathering, and analysis, and drawing conclusions.

Cumulative Biological Resource Impacts: Habitat Components

When rating the various habitat components, use the following general guidelines. Detailed measurement is not intended. The forester will, through adequate field observation, derive objective estimates of the quantity of the components necessary to accurately complete the ratings.

High variability in snag densities and downed large woody debris suggests however that a single average or range may not be appropriate for management over a wide range of landscapes (Stephens and Moghaddas 2005b).

Snags

Snags are a critical habitat component required by many wildlife species occupying forest lands. Estimate the number of snags per acre, then use the following to determine the quality of the snag resources. Snags are standing dead trees >16" DBH and 20 feet in height.
High >3 per acre; Medium = 1.5-3 per acre; Low <1.5 per acre; None = 0 per acre.

Downed large, woody debris

Downed logs in the terrestrial environment are a critical habitat component for many wildlife species. As they decay, downed logs contribute significantly to soil fertility. Estimate the number per acre of downed logs >16" diameter at the large end and >20 feet in length. Use the following to determine the quality of the downed log resource.
High >2 per acre; Medium = 1 to 2 per acre; Low <1 per acre; None = 0 per acre.

Multistory canopy

Multistoried canopies indicate vertical heterogeneity in the stand and influence diversity and density of wildlife species utilizing an area. Insectivorous birds are particularly influenced by multistoried canopies. This habitat condition is frequently encountered in riparian areas and late seral stage forests.
Estimate the percent of the stand composed of two or more tree layers on an average per acre basis. Use the following to determine the quality of the multistory canopy.
High >50%; Medium 25-50%; Low 10-25%; None <10%

Road Density
Excessive road densities remove land from production, fragment habitats, and disturb and displace wildlife. Vehicular traffic also causes mortalities to wildlife. Declines in deer and bear use have been noted in areas adjacent to frequently traveled, temporary and permanent roads. Estimate the miles of frequently traveled, temporary and permanent roads per section within the assessment area. Use the following to determine quality of the roads in the area.
High <1; Medium 1 - 2; Low 2 - 4; None >4

Hardwood Cover
Hardwoods are an important habitat component in the coniferous forest and are utilized by a large number of wildlife species. Productivity of deer and other species has been directly related to mast crops.
Estimate the basal area per acre within the assessment area provided by hardwoods of all species.
High >30 sq. ft.; Medium 10 - 30 sq. ft.; Low <10; None 0

Old-Growth Forest Characteristics
The MTHP does not provide for the modification of identified “old-growth” stands to achieve fuel reduction and forest resilience objectives. Guidance for the identification of “old-growth” forest conditions is provided in the Forest Practice Rules and below. The presence or absence of "old-growth" forest characteristics provides a basis from which to assess the influence of management activities on old-growth associated wildlife. The characteristics that indicate stand decadence typical of old-growth forests include large trees, multilayered canopy, and large numbers of snags and downed logs.
Use the following definitions to determine if the site is "old-growth" or contains significant old-growth characteristics.

1. Forests Not Previously Harvested:
Forests with no harvest history may have rare vegetation communities or wildlife populations which could be significantly affected by timber harvest. Forest stands can be any size that is meaningful to the biological resources of concern. For example, in some cases, 80 acres may be the minimum stand size for consideration. In other cases, stands as small as 5 acres may be considered. Two or more tree species with a wide range of ages and tree sizes as well as other old-growth forest characteristics should be present. The MTHP must specify the minimum block size used in the analysis.

2. Previously Harvested Forests:
Previously harvested forests may also include remnant patches of previously unharvested forest. Again, forest stands can be any size that is meaningful to the wildlife resources of concern. Previously harvested forests can be in any stage of succession and may include remnant patches of old-growth forests. Forests most likely to contain remnants of old-growth forests will possess many of the

necessary characteristics. These characteristics may not be uniformly distributed throughout the stand or assessment area. These characteristics include:

a. Two or more tree species of a wide range of ages and tree sizes with six or more large (<30 inch diameter) dominant, over mature (200 + years old) conifers per acre. Smaller associate trees may be conifer or hardwoods.

b. Multi-layered canopy.

c. Large (>16 inch diameter) snags and downed large woody debris (>10 tons per acre including 2 pieces per acre at least 16 inches in diameter and 20 feet long).

d. Decadence in dominant live trees which exhibit presence of broken or multiple tops and/or heart rot.

Estimate the amount of the assessment area occupied in total by forest stands with old-growth characteristics.

High >50%; Medium 25-50%; Low 10-25%; None <10%

3. Habitat Fragmentation

Habitat fragmentation and the resultant isolation of various habitat types are a significant factor influencing wildlife populations in an area. Fragmentation increases the amount of edge and reduces the continuity of habitats and seral stages. Estimate the proportion of the total land area in the assessment area occupied by stands with late seral stage characteristics that are in unfragmented blocks. Under the Forest Practice Rules, stands must be greater than 80 acres in size and less than one mile apart, or connected by a corridor of similar habitat, to be considered unfragmented. However, the thresholds for minimum size of unfragmented blocks and the distance between isolated blocks can be modified to fit local conditions and be meaningful to the biological resources of concern. The MTHP must specify the minimum size and distance used in the analysis.

High >50%; Medium 25 - 50%; Low 10 - 25%; None <10%

Cumulative Biological Resource Impacts Assessment

A. Biological Resource Inventory

The biological assessment area will vary with the species being evaluated and its habitat requirements. In addition, more than one species may be evaluated and the assessment area may be different for each species. To address cumulative biological impacts:

1. Identify any of the following categories of species known or suspected to occur on the assessment area(s) for the proposed timber operations:

rare, threatened, or endangered.

species of special concern (as defined in the Forest Practice Rules).

sensitive species.

2. Identify any other wildlife or fisheries resource concerns known or suspected to occur within the assessment area(s) of the proposed timber operations.

3. Describe the biological assessment area(s), including the reasons for boundary selection.

4. Describe the pre-project condition of the biological resources inventoried within the assessment area(s). Lastly, describe the anticipated post-project condition of these biological resources after the completion of the proposed project.

B. Habitat Condition

Describe the pre-project condition of the following terrestrial habitat components within the project area and assessment area(s). Lastly, rate the anticipated post-project condition of these habitat components after completion of the proposed project.

Habitat Components	Pre-Project On-Site	Pre-Project Off-Site	PostProject On-Site
1. Presence of snags/den/ nest trees	**H M L N**	**H M L N**	**H M L NC**
2. Amount of downed large woody debris	**H M L N**	**H M L N**	**H M L NC**
3. Presence of multistory canopy	**H M L N**	**H M L N**	**H M L NC**
4. Road density	**H M L N**	**H M L N**	**H M L NC**
5. Presence of hardwoods	**H M L N**	**H M L N**	**H M L NC**
6. Presence of late seral forest characteristics	**H M L N**	**H M L N**	**H M L NC**
7. Continuity of late seral stage forests	**H M L N**	**H M L N**	**H M L NC**

C. Presence of Significant Wildlife Areas

Are any of the following significant wildlife areas located on-site of your proposed operation and off-site within the assessment area(s)?

	On-Site	Off-Site
1. Deer fawning areas	**Y N**	**Y N**
2. Deer migration corridors	**Y N**	**Y N**
3. Deer winter range	**Y N**	**Y N**
4. Deer summer range	**Y N**	**Y N**
5. Wetlands	**Y N**	**Y N**
6. Riparian areas	**Y N**	**Y N**
7. Other	**Y N**	**Y N**

Will your operation significantly effect the use of these areas by wildlife?

___ Yes ___No

Explain your answer.

D. Other Projects

Identify and discuss the effects of the following projects within the assessment area(s) that might interact with the effects of the proposed timber operation:

1. Past and future projects in the biological assessment area(s) under the ownership or control of the timber/ timberland owner that did or could cause a significant impact on biological resources.

2. Past and future projects planned or expected in the biological assessment area(s) not under the control of the timber/timberland owner that did or could cause a significant impact on biological resources.

E. Interactions

Considering the interactions between
the biological resources of the assessment area (Parts A and C).
current habitat condition on-site and off-site (Part B).
the anticipated change in habitat (Part B).
the ongoing effects of past projects (Part D).
the effects of future projects (Part D).

What is the potential for developing significant cumulative effects on the biological resources of the assessment area(s) as a result of:

1. the proposed project combined with the effects of past projects without the impacts of future projects?
H M L

2. the proposed project combined with the effects of past projects and the expected impacts of future projects listed in Part D?
H M L

If the answer to both questions 1. and 2., above, is "low" go to Part F and check the line labeled "No."

If the answer to either or both questions 1. and 2., above, is "high" go to Part F and check the line labeled "Yes."

Otherwise, if questions 1. and 2., above, are both rated as "moderate" or as "moderate" and "low" continue with Part F and follow the instructions for impacts evaluation.

F. Impacts Evaluation

Based on the information gathered by the RPF, the contents of the MTHP, the forest practice rules, information from the review of other plans, the magnitude of impacts identified in parts A through D, and the interactions rated in Part E, is the proposed project likely to produce significant adverse cumulative effects to the biological resources within the assessment area(s)?

Yes or No

Explain your answer. If the answer is "yes", consider feasible alternatives to the proposed project and/or mitigation actions to avoid, minimize, reduce, or compensate significant adverse cumulative impacts to biological resources. These mitigation actions are additional to those in the forest practice rules. If the answer is "yes" proceed to questions 1. and/or 2, below. If the answer is "no", proceed to question 3, below.

Will the proposed project, as presented, in combination with the impacts of past and future projects as identified in Parts A through D, the interactions rated in Part E, and considering feasible alternatives and mitigation actions, have a reasonable potential to cause or add to significant cumulative impacts to biological resources within the assessment area(s)?

1. Yes (after mitigation) ...._____
2. No (after mitigation).._____
3. No (no reasonably potential significant effects)............................_____

If you answered question 1, above, describe any alternatives to the project that were considered and explain why they were infeasible or rejected. Also include a similar discussion of mitigations accepted, rejected, and/or infeasible.

If you answered question 2. and/or 3, above, and either or both of the questions in Part E are rated as "moderate" describe your reasons for reaching the conclusion.

Use separate sheets as necessary.

Literature Cited

Agee, J.K. and C.N. Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management. 211:83-96. Available online at www.sciencedirect.com

California Department of Forestry and Fire Protection (CDF). 1994. Guidelines for assessment of cumulative impacts. Sacramento, CA. 28p.

California Department of Forestry and Fire Protection--Fire and Resource Assessment Program. In Press. The 2010 Forest and Range Assessment. Sacramento, CA.

Finney, M.A. 2003. Calculating fire spread rates across random landscapes. International Journal of Wildland Fire. 12(2):167-174.

Garrison, B.A. 1991. Cumulative effects assessment for biological resources. California Department of Forestry and Fire Protection. Sacramento, CA. 23pp. http://library.ceres.ca.gov/docs/data/2400/2409/HYPEROCR/hyperocr.html

Graham, R.T., T.B. Jain, and S. Matthews. 2010. Fuel management in forests of the inland West. Pp 19-68. In: Elliot, W.J., I.S. Miller, and L. Audin (eds). Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rept. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 299p.

Leddy, J. 2010. Modified Timber Harvest Plan: fire behavior modeling runs. Final unpublished report. California Department of Forestry and Fire Protection, Sacramento, CA.

Lutz, J.A., J.W. VanWagtendonk, A.E. Thode, J.D. Miller and J.F. Franklin. 2009. Climate, lightning, and fire severity in Yosemite National Park, California, USA. International Journal of Wildland Fire. 18:765-774.

Mayer, K.E. and W.F. Laudenslayer. 1988. A guide to wildlife habitats of California. State of California, Resources Agency, Department of Fish and Game Sacramento, CA. 166 pp.

Miller, J.D., H.D. Safford, M. Crimmins and A.E Thode. 2008. Quantitative evidence for increasing forest fire severity in the Sierra Nevada and southern Cascade Mountains, California and Nevada, USA. Ecosystems. 12(1):16-32.

Richter, D.J. 1993. Snag Resource Evaluation. CA Department of Fish and Game, Environmental Services Division, Admin. Report. 93-1.

Stephens, S.L. and J.J. Moghaddas. 2005a. Experimental fuel treatment impacts on forest structure, potential fire behavior, and predicted tree mortality in a California mixed conifer forest. Forest Ecology and Management 215:21-36. Available on line at www.sciencedirect.com

Stephens, S.L. and J.J. Moghaddas. 2005b. Fuel treatment effects on snags and coarse woody debris in a Sierra Nevada mixed conifer forest. Forest Ecology and Management 214:53-64. Available on line at www.sciencedirect.com

Weatherspoon, C.P. and C.N. Skinner. 1996. Landscape-level strategies for forest fuel management. Pp1471-1492. In: Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessments and scientific basis for management options. University of California Davis, Centers for Water and Wildland Resources. Davis, CA.

Appendix A

Performance Based Principles for Retention of Special Habitat Elements

A fuel management strategy is desired that addresses short-term fuel treatment objectives and incorporates longer-term and larger scale biological diversity and habitat protection objectives. Fire and fuels management research increasingly supports the general findings that:

> Thinning may not be an effective substitute for fire in affecting ecosystem processes. Reducing surface fuels is as important as reducing ladder fuels, fundamental elements of any fuel treatment include reducing surface fuel loads, not substantially increasing surface fuel loads by adding activity fuels and adequately raising height to crown base to reduce passive crown fire. Solely reducing crown bulk density with crown thinning alone does not substantially change potential fire behavior or effects
>
> "Average" stand conditions are rare in active-fire forests because the interaction of fuels and stochastic fire behavior produced highly heterogeneous forest conditions. Creating "average" stand characteristics replicated hundreds of times over a watershed will not produce a resilient forest, nor one that provides for biodiversity.
>
> Topography and slope position may provide a useful guide for varying treatments and maintenance of biological diversity. Within stands, important stand topographic features include concave sinks, cold air drainages, and moist microsites.
>
> Tree diameter distributions in active- fire forests vary but often have nearly equal numbers in all diameter size classes because of periodic episodes of fire-induced mortality and subsequent recruitment.
>
> The spatial pattern of fuel treatment across a landscape will likely determine its effectiveness at modifying fire behavior and severity. Treating small or isolated stands without assessing the broader landscape will most likely be ineffective in reducing wildfire extent and severity. Random fuel treatment arrangements are extremely inefficient in changing fire behavior.

Criteria and Indicators

I Maintenance of biological diversity and ecological functions

A. Provide measures designed for the protection of key wildlife habitat or habitat elements at the project and landscape (e.g. watershed) scale. Negative effects identified at the project scale may translate to positive effects when larger scale ecosystem drivers such as fire at the scale of the landscape are assessed. Habitats and habitat elements may include key winter range or migration routes, late successional stands, hardwood/aspen groves, riparian or wetland areas, snags, large down woody material, or den trees.

B. Identify those ecological process restoration opportunities that the proposed project will achieve. For example, to what degree do reductions in stem density and canopy cover emulate the stand structure produced by local potential fire behavior, varying by a site's slope, aspect, and slope position.

II Planning and monitoring of operations

A. Identify those measures and silvicultural practices proposed to reduce the rate of fire spread, duration and intensity, fuel ignitability, and ignition of tree crowns. Provide for fuel reduction balanced with ecosystem (disturbance regime) restoration, and wildlife habitat objectives.

B. Provide operational procedures to protect key habitats and/or special habitat elements. These include but are not limited to project site layout, firing pattern, line construction etc. Consider the timing of treatments as they relate to the seasonal requirements of wildlife or plant phenology and describe long-term benefits.

C. Assess the degree to which the proposed project will complement current landscape scale fuel treatments (i.e., SPLATs, DFPZs, and WUI defense zones) or support the objectives of the California Fire Plan or similar local planning effort.

D. Provide a means of monitoring the rate and extent of project implementation as well as maintenance requirements over time.