

Management and Monitoring of Forests, Habitats and Habitat Elements within Red River Forests



PREPARED FOR:

Red River Forests LLC

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1.0 INTRODUCTION

The overall goal guiding the forest management of Red River Forests LLC (Red River Forests) is to provide for sustainable commercial timber production while maintaining healthy forest ecosystems. Healthy forest ecosystems are capable of maintaining soil productivity and providing non-timber attributes such as clean water, wildlife habitat, livestock forage, and recreational opportunities (Thomas 1979). Providing sustainable commercial timber production and the amenities of a healthy forest ecosystem also meets the landowner's intent to support employment and long term regional economic vitality.

1.1 RED RIVER FORESTS LLC

Red River Forests shares an ownership history in northeastern California forestland acquired in the late 1800's and early 1900's by Thomas B. (T.B.) Walker and John E. Andrus. In particular, T.B. Walker owned The Red River Lumber Company and a 50 percent interest in the Waland Lumber Company that was administered by The Red River Lumber Company based in Westwood, California. Over the following several decades, differences in ownership objectives led to a partitioning of the ownership and the eventual formation of the Red River Forests Partnership in 1994. The lands owned by Red River Forests Partnership amounting to approximately 134,299 acres now comprise Red River Forests LLC. Effective August 31, 2021, Red River Forests LLC, was divided into six subsidiary California limited liability companies, RRF Jimmerson LLC, RRF Lassen-Plumas LLC, RRF Pondosa LLC, RRF Shasta LLC, RRF Westwood LLC, and Slate Mountain Renewables LLC. Red River Forests LLC is the sole member of each of these six Manager-Managed LLCs. These lands are certified under the Forest Stewardship Council's (FSC®) Pacific Coast Standards (Standards) as a well-managed forest. W. M. Beaty & Associates, Inc. (WBA), as consulting managers for Red River Forests, has developed the forest management guidelines described in this report to meet all applicable federal and state laws, regulations and codes, and also achieve the Standards of the FSC®.

2.0 FOREST MANAGEMENT

To meet the goal to maintain healthy forests and suitable wildlife habitat over time, the expertise of professional forestry and wildlife personnel is used. Information needed to inform management and monitoring activities to meet forest and wildlife objectives, is provided by incorporating forest and habitat types and special habitat elements into resource inventories and land-based data management. Also, forest management plans for particular Threatened and Endangered (T&E) species are developed in cooperation with California Department of Fish & Game (DFG) and United States Fish & Wildlife Service (USFWS) to ensure against direct or indirect harm to protected wildlife and to promote the long-term maintenance of diverse habitats.

The long-term maintenance of healthy watersheds, including soils, water quality, riparian habitat, livestock forage, aesthetics and recreation, is an important objective for the landowners. Appropriate forest management and erosion control practices are used to sustain the long-term productivity of the soils as well as maintain and enhance the objectives.

It is well described that management and monitoring needs to be designed around multiple ecological scales (Layton et al, 2003), yet recognize the temporal changes that occur at multiple ecological scales from both natural and manmade disturbances (White and Walker 1997). Accordingly, forest, biological and watershed resource management and monitoring of Red River Forests is also designed around the recognition of the various scales that occur within the forested landscape: (1) Natural disturbance regimes, (2) Ecological scales, and (3) Temporal scales.

2.1 HISTORICAL FOREST CONDITIONS

Accounts or scientific data that describe vegetation condition in the 1800's is scattered and not comprehensive (McKelvey and Johnston 1992). Early written accounts of vegetation condition in the 1800's were made by explorers and naturalists. Most notably, John Muir described "...the forested belt of the Sierra where wildfires seldom or never sweep over the trees as they do in the dense Rocky Mountains or the Cascade Mountains of Oregon and Washington. Forester S. B. Shaw described forests in the Southern Cascades as "... so uneven-aged and broken and have such a varied cover type that continuous crown fires are practically impossible...".

Between 1890 and 1910 several surveys of the vegetation in the Southern Cascades and Sierra Nevada were commissioned. The United States Geological Service initiated the first surveys in Sequoia National Forests and Yosemite National Park in 1890, Eldorado and Stanislaus National Forests in 1900, and Tahoe, Plumas and Sierra National Forests in 1902. The surveys or inventories were designed systematically and represent the best data on vegetation condition at the turn of the century. These early inventories found mixed-conifer types included all conifer species found presently today. Also, trees over 24" diameter were common in the overstory. Larger diameter trees from 3 to 5 feet in diameter and 150 to 180 feet tall were present in these forests (Sudworth 1900a). Where sheep had been removed from the forests, regeneration was common (Leiberg 1902). Tree species composition today in the Stanislaus and Tahoe National Forest appear similar to composition observed at the turn of the century (Sudworth 1900b). However, current tree species composition around the Plumas National Forest have more true-fir, incense cedar and less pine than the early 1900's (Moore 1913). When averaged across the Sierra Nevada, tree density as measured by basal area and canopy closure significantly higher today than observed in the early 1900's (McKelvey and Johnston 1992). This in addition to fire suppression policies have led to a significant increase in fuel loading throughout the Sierra Nevada and Southern Cascades. Most recently these fuel loads combined with prolonged drought have brought about some of the worst fire seasons in recent history.

Red River Forests currently manage to promote a natural diversity of vegetation types. Tree species currently found are similar to those species found by early explorers, naturalists and later by foresters. As compared to early forest inventories, these forests currently contain greater tree density, basal area and canopy closure than historical forest conditions. These forests also currently contain relatively large overstory trees in excess of 24" in diameter, similar to the tree sizes commonly found in early forest inventories. However, these forests, like many in the Southern Cascades and Northern Sierra Nevada currently do not contain

numerous examples of overstory trees, snags and large woody debris in excess of 3 to 5 feet in diameter. Current existing forest management plans and management guidelines that are summarized in this document are designed to improve the maintenance and recruitment of these larger diameter trees, snags and large woody debris (also see below Section 4.4 and 4.5). Also, detailed existing forest inventory information and forest growth modeling (Timber Management Plan) indicates that the ownership-wide QMD will increase over the next 100 years of forest growth and management (Timber Management Plan).

2.2 DISTURBANCE REGIME

Natural disturbance regimes are one part of creating the natural mosaic of vegetation patterns of an ecosystem. The natural disturbance regime can be best described by disturbance type, frequency and severity. Natural disturbances can include, but not limited to, wildfire, windthrow, both chronic and episodic disease and insect events typically initiated by drought conditions and potential climate changes. However, anthropogenic disturbances including, but not limited to, wildfire, timber harvesting, transportation right-of-ways, railroads, roads and highways, grazing, construction of communities and most notably fire suppression have all influenced the forests we see today.

Prior to written records, in the Southern Cascades and Northern Sierra Nevada, both frequent low-intensity wildfires and more episodic mixed-severity fires were common (North et al. 2009, Swetnam et al. 1999). Natural or anthropogenic caused disturbances, like wildfire, have influenced vegetation patterns in the Southern Cascades and Northern Sierra Nevada for thousands of years (Scholl and Taylor 2010, North et al. 2009). Native Americans on both the west slopes (School and Taylor 2010) and east slopes (North et al. 2009) of the Sierra Nevada used wildfire to improve habitat for their exploitation of wildlife and other resources (Vankat 1970, Lewis 1973). Due to the long-term existence of both natural and anthropogenic disturbances and the difficulty to separate or measure the effects of the natural disturbances versus anthropogenic disturbances, herein after, we refer to all disturbances in terms of a "natural disturbance regime".

Tree ring based climate reconstruction data (Fritts and Gordon 1980) has confirmed that disturbances in the Southern Cascades and Northern Sierra Nevada included natural and anthropogenic wildfires, and several extended periods of drought conditions. Most notably the periods of 1750 to 1820 and again 1860 to 1880 were periods of extended drought conditions (Fritts and Gordon 1980). By the late 1800's, observed vegetation communities were typically large, scattered, older trees with little understory vegetation.

By the early 1900's, natural disturbance regimes estimated from comparison between early inventories and current scientific information verified that both natural and anthropogenic disturbances were typically of low intensity and frequent. Prior to 1900, in the Central Sierra Nevada wildfires were common with a mean fire return interval of 12 years (School and Taylor 2010). Mean fire interval using tree rings dating back prior to the 1800's found fire return intervals in the eastern Sierra Nevada ranged from 4.8 years to 16.9 years at lower elevations (mean = 10.9 years) and from 13.4 years to 45.7 years at higher elevations (North et al 2009). Research has found, in general, as annual moisture increases and ambient temperatures

decreases, with increases in elevation and longitude, the subsequent potential drought conditions decrease resulting in larger disturbance return intervals (Martin et al. 1979, Miller and Urban 1999). In other words, latitudes that are more northern and higher elevations have larger disturbance return intervals than more southern latitudes and lower elevation areas.

Forest management planning and silviculture currently used on Red River Forests attempts to mimic these natural disturbance regimes by:

- (1) Management plans include harvest return intervals of 10 to 20 years.
- (2) At the stand scale, attempts are made to create fine-scale canopy gaps (North and Keeton 2008) through use of selection and group-selection silviculture.
- (3) When existing stand conditions indicate more intensive stand management is necessary to improve forest health, variable retention silviculture is used to retain disperse or aggregate retention of trees similar to historical disturbance regimes (Kohn and Franklin 1997, North and Keeton 2008).
- (4) When economic conditions permit their use, commercial thinning and biomass thinning of over stocked forests has been applied extensively to further mimic more open forest historical conditions and to reduce the potential threat of catastrophic wildfire.
- (5) When stand replacing wildfire has impacted the ownership quick action is taken to salvage and restore stands to a forested condition while also looking for opportunities to restore biological and watershed function across the impacted landscape.

In summary, these silvicultural prescriptions not only mimic natural disturbance regimes but help maintain or enhance retention of biological legacies in our forests which help maintain or enhance our contribution towards biological diversity and overall ecosystem sustainability. We also believe, the management plans and silvicultural prescriptions also meet the intent and specific requirements of FSC®-US Forest Management Standard (v1.0) C6.4 and Indictors 6.4.a and 6.4.b.

2.2 ECOLOGICAL SCALE

There is no single forestland classification scheme that is better than another at management and monitoring of forest diversity or for species and maintenance of biological diversity (Pregitzer and Goebel 2000). Many have supported a hierarchical approach to management and monitoring that mimics the biological organization of nature or scales (Pregitzer and Goebel 2000). The biological scales of nature follow a series of nested levels, each of the lower scales are dependent on physical conditions in the larger scale for the development of ecological conditions. For the purposes of the forest, biological and watershed resources, resources will be described, measured and monitored at the sub region scale (i.e. landscape) and then at various forest management scales (i.e. stand and species). A goal of the management and monitoring is to validate contributions of managed forests at the various monitoring scales: Landscape, Stand and Species (see Appendix D, Monitoring of Forest and Biological Resources).

2.3 TEMPORAL SCALE

Management and monitoring should also be done over a long enough time period to incorporate the range of environmental conditions allowing for valid estimates of management actions (White and Walker 1997). The appropriate time period may be as short as one year, as an example, when estimating response of a rare species to specific auditory disturbances during the breeding season. However, multiple years of management and monitoring may be needed to identify responses, if any, to changes in habitat types by species (Monitoring of Forest and Biological Resources, Appendix D).

3.0 LANDSCAPE LEVEL MANAGEMENT - FOREST TYPES

As previously stated, the overall objective guiding the management of Red River Forests is to provide for sustainable commercial timber production while maintaining healthy forest ecosystems. In order to accomplish these long-term objectives, management and monitoring activities will be implemented to achieve a regulated forest structure over time. Accordingly, timber harvesting and other management activities are designed to create a sustainable distribution of size and age classes for each vegetation type. An additional landowner objective is to maintain existing suitable forest cover on a landscape scale while maintaining stand conditions that mimic natural processes. These objectives have led to the extensive use of unevenaged silvicultural methods (i.e. selection harvest). The use of evenaged silvicultural methods (i.e. clearcut harvest) occurs when understocked stands or stands without adequate regeneration warrant use of these techniques to improve overall stand conditions. The use of salvage treatments occurs when natural events like wildfire, windthrow or insect epidemics damage forest types. These management objectives also maintain suitable wildlife habitat over time for a diversity of native wildlife species.

Information needed for management and monitoring activities will be provided by incorporating habitat types and special habitat elements into resource inventories and GIS based databases. Current and future forest vegetation is described in the Timber Assessment and contained in GIS databases.

In addition, the objectives for long-term forest management and wildlife habitat maintenance include planning to maintain a distribution of vegetation types and seral stages within each planning watershed by the end of each 10-year period across the 100-year planning horizon. By maintaining a distribution of these stages within pre-defined ranges, a variety of forested habitats will be present over time. By maintaining this distribution within the natural range of variability across planning watersheds, a “shifting mosaic” (Kohm and Franklin 1997) of habitats will exist at appropriate ecological scale and temporal scales.

3.1 GAP ANALYSIS - WITHIN THE FOREST MANAGEMENT UNIT

During the preparation and development of the Red River Forests Timber Assessment, an assessment of the distribution of forest stand types and seral stages was completed (see Appendix E, Timber Assessment). Also, a wildlife habitat assessment was completed to identify: (1) Unique habitats not common in portions of the forests, (2) Habitats by type and seral class and identify any significant changes over time, (3) Guilds of species by habitat type and seral

class to better understand any potential impacts of species, and (4) Monitoring and adaptive management. These assessments identified the following key forest stand and wildlife habitat types that need additional consideration when forest management activities are planned:

- (1) Late Successional or Mature Stands: The current number of forested stands and acreage meeting late-successional definitions (size class 5M, 5D and 6) are currently less than 1% for Red River Forests. Based on current management practices and modeled forest growth projections areas that meet the late-successional definitions should increase overtime on Red River Forests.
- (2) Snags and Large Woody Debris: An important habitat element in all forest stand types and seral stages. Specific guidelines have been developed for maintenance of existing elements and enhanced recruitment for future elements (see Timber Assessment, Section II.G. Snags and Large Woody Debris, and Section 4.5, Forest Structural Elements, of this document)
- (3) Hardwood Trees and Aspen Stands: Hardwood trees as habitat elements in our conifer forests and aspen stands are important habitat types within our landscapes. Specific management guidelines are described in the Timber Assessment for hardwoods (Timber Assessment, Section II.H. Hardwoods) and in Section 4.5, Forest Structural Elements, of this document.

Specific to certification under the FSC®-US Forest Management Standard (v1.0), a GAP analysis is to be completed to identify any potentially under represented vegetation or wildlife habitat types in the forest management unit. In general, GAP analysis is based on our known associations between vegetation types and wildlife species and overall biodiversity patterns (Thomas 1979). Since it is usually impractical to survey and map all the plants and wildlife species found within a forest management unit, mapping of vegetation types and seral stages is completed, and groups of species or guilds, based on known habitat use associations, are assessed. The GAP analysis then identifies any vegetation types, vegetation seral stages, specific guilds of species or individual sensitive species where amounts of habitat that may be relatively low or poorly distributed (WDFW 2011). The analysis then identifies specific guidelines or measures, at the appropriate ecological and temporal scales, to improve forest management unit conditions.

The Timber Assessment completed during post Dixie Fire considered all habitat types and seral stages including unique habitats, identified any significant changes over times, linked guilds of species to habitat types and seral stages and identified potential "gaps" or area needing specific management guidelines. We believe, the updated Timber Assessment, previous Fish and Wildlife Assessments and subsequent assessments completed for individual THPs also meet the intent and specific requirements of FSC®-US Forest Management Standard (v1.0) C6.4 and Indicators 6.4.a and 6.4.b for within the forest management unit

3.1 GAP ANALYSIS - OUTSIDE THE FOREST MANAGEMENT UNIT

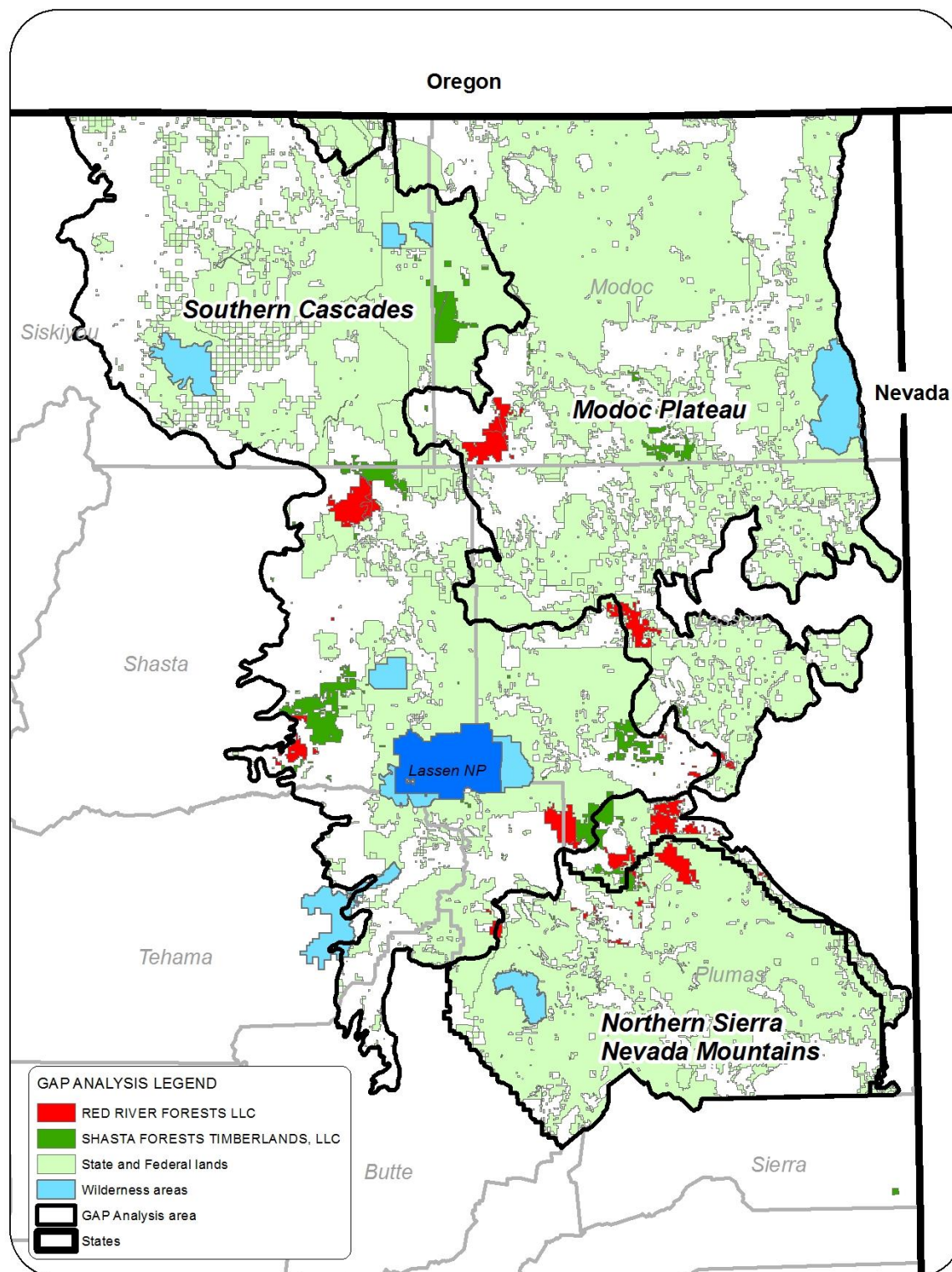
Specific to certification under the FSC®-US Forest Management Standard (v1.0), a GAP analysis was completed to identify any potentially under represented vegetation or wildlife habitat types outside the forest management unit. Specifically, the GAP analysis was guided by the

intent and specific requirements of FSC®-US Forest Management Standard (v1.0) C6.4 and Indicators 6.4.a and 6.4.b.

3.1.1 GAP ANALYSIS - GEOGRAPHICAL AREA

The GAP analysis for areas outside of the forest management unit were geographically bounded by the ecological units (USDA 1997) within the State of California (Figure 1). Recent scientific studies have verified that biophysical factors like climate, elevation, slope, aspects, landscape position, disturbance history and frequency and geologic history influence the vegetation and biological diversity found in land types (Hansen *et al*, 2002). Ecological regions are described based on associations of those environmental factors that directly or indirectly regulate structure and function of ecosystems and are mapped in the Ecological Subregions of California (USDA 1997). The ecological regions also include sub-regions that were described in terms of geomorphology, lithology, soil taxa, vegetation, fauna, climate, surface water, disturbance regimes, land use and cultural ecology. This GAP analysis focused on all three ecological regions that the forest management unit lies within: Southern Cascades, Modoc Plateau and the Northern Sierra Nevada Mountains. To make the GAP analysis more relevant to the forest management unit, only the Southern Cascades and Modoc Plateau in California was considered and only the Northern Sierra Nevada Mountains in Plumas and Lassen counties was considered (Figure 1).

Figure 1 GAP Analysis - Outside the Forest Management Area



The presence of specific forest types, stand seral stages and subsequent wildlife habitats that occur within the GAP analysis area are dependent on both the physical factors described above, but also on additional environmental factors. These additional environmental factors may include disease, competition and various stochastic processes like drought, fire, and extreme weather events. These factors may increase or reduce a tree, vegetation or wildlife species presence or distribution either above or below expected levels for various habitat conditions (O'Neil and Carey 1986; Airola 1988). Accordingly, during the GAP analysis both physical and environmental influences within the GAP analysis area were considered.

3.1.2 GAP ANALYSIS - LAND OWNERSHIP AND MANAGEMENT

The GAP analysis area is approximately 9.3 million acres, generally consisting of forest, range, pasture and agricultural land. A portion of the area contains small towns, urban areas and state and county roads. Approximately 3.5 million, 4.2 million and 1.6 million acres occur in the Modoc Plateau, Southern Cascades and Northern Sierra ecological regions, respectively. State and federal agencies own and manage 5.6 million acres or 60% of the area and 40% is own and managed by private landowners (Figure 1, 2).

Figure 2 GAP Analysis - Outside the Forest Management Unit (acres)

State or Federal Landowner	Acres (Thousands)
Bureau of Land Management	843
Bureau of Reclamation	1
U.S. Forest Service and Wilderness	4,477
U.S. Fish and Wildlife Service	98
National Park Service	154
California Department of Fish and Game	50
California Department of Park and Recreation	12
California Department of Forestry and Fire Protection	9
Total	5,644

There are approximately 327,000 acres or 3.5% of the GAP analysis area within state and federal parks and monument areas, wilderness areas and special management areas within the GAP analysis area. The larger parks and wilderness areas include Lassen National Park and Caribou wilderness (122,000 acres), South Warner wilderness (70,000 acres) and Mt. Shasta wilderness (37,000 acres) and Ishi wilderness (42,000 acres). The U.S. Forest Service also manages approximately 4.5 million acres which includes portions of the Klamath, Shasta-Trinity, Modoc, Lassen and Plumas National Forests.

3.1.3 GAP ANALYSIS - FOREST TYPES AND WILDLIFE HABITATS

Similar to the GAP Analysis conducted within the Forest Management Unit (see Section 3.1), the analysis for areas outside the Forest Management Unit focused the distribution of, and existing management plans for, forest stand types, seral stages and wildlife habitats. Key issues identified during the analysis were:

(1) Late Successional or Mature Stands: The GAP analysis area contains approximately 327,000 acres or 3.5% within state and federal parks and monument areas. Wilderness areas that have specific management plans to ensure late-successional or mature stands are present within these areas. These areas are some of the most intact, best examples of Representative Sample Areas (RSA) in western North America. In addition, portions of the Klamath, Modoc, and Shasta-Trinity National Forests are managed under programs of the Northwest Forest Plan (USDA 1993). The Northwest Forest Plan is designed to maintain a viable forest ecosystem for the maintenance or enhancement of all wildlife species present, including those dependent on late-successional or mature stands, within the ecological provinces. In addition, the U. S. Fish and Wildlife Service (USFWS 2011) has recently proposed in a Revised Recovery Plan for the Northern spotted owl that many of these same late-successional stands as critical habitat. This designation would ensure continued existence of late-successional stands throughout the Klamath, Modoc and Shasta-Trinity National Forests for the foreseeable future.

The Plumas and Lassen National forests in the Modoc Plateau, Southern Cascades and Northern Sierra Nevada Mountains ecological regions are managed under programs of the Sierra Nevada Forest Plan (2001). The Plan includes, but is not limited to, protecting all trees greater than 20" in diameter, protection of all existing old-growth habitats and plans to promote growth of mature stands into old-growth stands. It also includes protection of late-successional California spotted owl habitats, protection of critical aquatic habitats and conservation of late-successional fisher habitat. In summary, based on; (1) The significant amount of federal land ownership (48%) in the GAP analysis area, (2) Existing federal management plans and conservation efforts to protect and enhance late-successional forests, (3) Amount of existing state and federal parks and monument areas, wilderness areas and special management areas (3.5%) within the GAP analysis area, late-successional or mature forest as well represented, distributed and protected throughout the GAP analysis area.

(2) Risk of Catastrophic Wildfire: The Southern Cascades, Modoc Plateau and Northern Sierra Nevada Mountains are at high risk of catastrophic wildfire. While both low-intensity and more episodic catastrophic wildfire have been common in the historic past (North et al. 2009, Swetnam et al. 1999), risk of catastrophic wildfire has been increased by management plans designed to protect late-seral forest and wildlife habitats (USFWS 2011). This became clear during the Dixie Fire where almost one million acres burned in the Plumas and Lassen National Forests. These same management plans have proposed forest management activities which would lessen the risk of catastrophic wildfire, including thinning of spotted owl habitats and returning fire reoccurrence intervals to those observed in the historic past (North and Keeton 2008, USFWS 2011)

Accordingly, we found no "gaps" relating to the protection or enhancement of forest types, seral stages or wildlife habitats outside of the forest management unit. However, improved management of fuel loads that may contribute to catastrophic wildfires, which could impact present and distribution of forest types, seral stage, wildlife habitats and species like the Northern and California spotted owls and fisher, should be a focus of management plans both within and outside the forest management unit. We believe this analysis meets the intent and specific requirements of FSC®-US Forest Management Standard (v1.0) C6.4 and Indicators 6.4.a and 6.4.b for outside the forest management unit.

4.0 STAND LEVEL MANAGEMENT

Several key vegetation types or habitat types and elements have intrinsic value for overall plant and wildlife biological diversity. Wildlife species or species guilds are associated with particular habitat types or elements. Assessment of these species and guilds was completed during previous assessments. Some of the species in the guilding assessment are rare, threatened or endangered species, while others are important as game species or some fill ecological niches critical to ecosystem function. During previous assessments, key vegetation types, habitat types or habitat elements were identified for additional consideration. Development of specific management guidelines were included for: (1) Riparian Habitats, (2) Wet and Dry Meadows, (3) Rock, Talus Slopes and Cliffs, (4) Late Successional and Mature Forests, (5) Snags, (6) Large Woody Debris, (7) Hardwoods, (8) Aspen, and (9) Wildlife Trees.

4.1 RIPARIAN HABITATS

Riparian habitats can support a unique diversity of plant and wildlife species. Many aquatic and terrestrial wildlife species (vertebrates and invertebrates) are known to use riparian areas disproportionate to availability. Riparian areas provide food and water resources, thermal and escape cover, and important travel corridors for terrestrial wildlife. Riparian zones also contribute to the ecological integrity of freshwater habitats and influence the primary factors affecting aquatic organisms. Some of these factors include: water flow, temperature, organic input, bank stability, sediment transport, and nutrient cycling.

Areas that function as riparian zones adjacent to watercourses and lakes are generally protected through the Watercourse and Lake Protection Zones (WLPZ). Extra protection is often provided by establishing Equipment Limitations Zones (ELZ) that are not required by the FPRs around springs, seeps, and Class III watercourses beyond the requirements of the Forest Practice Rules (FPR). The predominant hardwood tree species (i.e. alder, aspen, vine maple, willow) that occupy these sites are not commercially harvested. In general, only sanitation/salvage treatments are used in riparian areas and thereby retain more habitat than is required by the FPR. To continue to maintain or enhance riparian habitats within our forests, we have developed the following guidelines. The guidelines described below may be modified as new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) Retention of all existing unmerchantable snags and large woody debris (LWD).

- (2) Retention of any tree leaning across a Class I or II watercourse that cannot be removed without impairing watercourse channel conditions.
- (3) Use of silvicultural prescriptions and WLPZs designed to increase growth rates of large diameter conifers and recruit habitat structure and elements
- (4) For watersheds that support listed aquatic species, salvage operations in WLPZs shall employ methods necessary to prevent long term adverse impacts to watershed and aquatic resources. As such, all non-merchantable trees and LWD within WLPZs shall be retained and only sanitation/salvage or selection marking criteria shall be applied. Any healthy trees shall be retained during salvage operations.

Also, if necessary, measurements or estimates of the physical properties associated within WLPZs subject to salvage operations under exemption and/or emergency notices shall be made. These measurements may include: identifying trees and LWD that shall be or were retained both before and following salvage operations necessary in WLPZs. Canopy closure in WLPZs may be measured or estimated before salvage operations are conducted and monitored for a period of 1 to 3 years after harvesting operations are complete. Sediment bedload, waterflow, pool volume, and channel bank stability may be measured or estimated as needed to verify that increased sedimentation is not adversely affecting water quality or aquatic resources. All erosion control facilities will be constructed, maintained, and monitored to ensure they are properly functioning.

In general, most watercourse channels have experienced very little significant change over the past 10 years. Notable exceptions are areas where crossings have been upgraded, restorative work on roads within WLPZs has occurred, and in areas impacted by catastrophic wildfire.

4.2 WET AND DRY MEADOWS

Wet and dry meadows can support unique vegetative communities. Species of aquatic, terrestrial wildlife and some native plants are closely associated with seasonal or permanent wet meadows. The geographic location and porous volcanic substrates limit the amount of wet meadow habitat within the assessment area. Because of their seasonal nature, most of the wet areas do not meet the definition of “Wet meadows and other wet areas” found in the FPRs. They also do not meet the California Wildlife Habitat Relationships (CWHR) definition for this habitat type because they are not permanently wet. Nonetheless, the seasonally wet areas that occur in this region may function as wet meadow habitat for part of the year and are protected accordingly.

Typically, an ELZ is established around the boundary of habitat so that disturbance to wildlife and habitat is avoided. It should be noted that ELZ protection measures minimize soil compaction, disturbance to plants, and disperse drainage patterns. Detailed and comprehensive assessments and site specific measures used to maintain wet and dry meadow habitats and the species that use these habitats are described in specific timber harvesting plans (THPs).

4.3 ROCK, TALUS SLOPES AND CLIFFS

Rock, talus slopes and cliffs can support unique vegetative communities and support several species of birds, bats and other wildlife which use rocky areas and cliffs for nesting, cover, or other life functions. There are some areas of Red River Forests that provide canyon habitat, usually along watercourses. In addition, lava reefs provide some topographic relief but no known nest sites for cliff dwelling raptors or other special status wildlife are known to occur in these habitats. If cliffs or rocky areas are thought to be providing wildlife habitat that could be adversely affected by timber operations, site specific mitigation measures will be developed between the forester, wildlife biologist, and any other appropriate regulatory agency biologist(s). Detailed and comprehensive assessments and site specific measures used to maintain rock, talus slopes and cliff habitats and the species that use these habitats is described in the specific THPs that may impact this habitat type.

4.4 LATE SUCCESSIONAL AND MATURE FORESTS

Late successional and mature forests can support unique vegetative communities that provide habitat for many species of wildlife. Since 2000, there has been a formal management for late successional and mature forests. As defined in FPR, a “Late Succession Forest Stand” meets the CWHR classification of 5M, 5D, or 6 with an open, moderate or dense canopy closure, may have multiple canopy layers, contains decadent elements such as large snags and down logs, and is at least 20 acres in size. The FORSEE growth and yield modeling software is used to simulate growth of stands 20 years of age and older (Timber Assessment Appendix E). The FORSEE CWHR calculations are based on the program developed by Greenwood and Eng 1993 and are applied to the forest inventory data. Based on existing data, no stands currently occurring on Red River Forests meet all of the criteria of a late-successional forest stand.

4.4.1 *Type 1 and 2 Old Growth Stands*

It should be stressed that the reason that no stands currently meet the definition of “late succession forest stand” is probably more related to the CWHR classification system as it applies to unevenaged timber stands, than to the lack of late-seral and mature forest attributes. There are few previously unmanaged timber stands on Red River Forests. Although the inventory shows a component of large diameter trees in most stands, the average diameter is lowered by the high number of small diameter trees present. These small trees are necessary in unevenaged stands to sustain stand structure over time, but when used in the calculation of CWHR types, lowers the quadratic mean diameter(QMD) below the minimums needed for late-successional designation. In addition, managed forests do not typically contain the decadent conditions found in old growth forests. Decadence in the form of very large, old trees, mistletoe infestations, and other features is also limited because of periodic harvest and sanitation/salvage operations designed to improve stand vigor and capture the economic value of dead and dying trees. While truly decadent “old growth” stands are not present, large snags, culls, and large woody debris are identified and retained where they exist to provide habitat for wildlife species that use these late seral elements. Large trees (≥ 30 ” diameter at breast height (DBH)), snags, and woody debris are recruited into stands by applying selection silvicultural prescription harvests without regard to diameter.

For timber stands in the future that meet the criteria of CWHR habitat type 5M, 5D, or 6 and are at least 20 acres in size, an analysis will be conducted to determine if they possess late successional characteristics (i.e. large snags, large woody debris, decadence, etc.). Stands will be examined on the ground to determine if late successional elements are present and to what degree they are exhibited in the stand (i.e. number of snags and pieces of large woody debris per acre).

The difference between late successional and mature stands is tenuous. Elements that make mature stands function as late successional stands and are important to the biotic function within these stands include: large diameter overstory trees, younger trees that make up one or more understory canopies, and a certain amount of decadence. Decadence can be in the form of large, old culls and snags, deformed or damaged trees, large woody debris, and background levels of disease, pests, and pathogens. However, tree densities within natural old growth forests are also influenced by abiotic factors such as precipitation, soil productivity and disturbance regime. So, in some forests, it is unlikely that many eastside pine forests ever maintained canopy closure values that approached 60% canopy closure (Kaufmann et al. 2007) and stands of uniformly large trees did not occur in patches approaching 20 acres in size (Youngblood et al. 2004).

To continue to maintain or enhance older forests, we have developed the following guidelines. The guidelines described below may be modified as new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) Old and Large Tree retention guidelines
- (2) Old and Large Tree retention - rehabilitation guidelines
- (3) Snag and Green Culls guidelines
- (4) Riparian Habitats and High Conservation Value Forests guidelines

We believe this review and the specific management guidelines described meet specific guidance for certification under the FSC®-US Forest Management Standard (v1.0), Type 1 old growth stands (minimum 20 acres containing old growth trees or structures) and Type 2 old growth stands (minimum 3 acres of undisturbed old growth trees or structures).

4.4.2 Old and Large Tree Retention

Specific to FSC® certification, in 2000, and further refined over the past two decades, a site-specific approach was developed to identify and manage old and large tree retention. Initial entries of timber management removed most of the old growth timber that was present. Since initial removal of older forests, management has been primarily limited to selection silvicultural prescriptions designed to increase the health and vigor of the forest and promote the growth of individual trees into large diameters. However, these stands have not had the time to develop high densities of trees as large as the old growth. It should be noted that the size of old growth trees varies by site. On dry sites, precipitation and soil qualities serve to limit tree size regardless of age. To continue to maintain or enhance older forests and forest elements, we have developed the following guidelines. The guidelines described below may be modified as

new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) Green Cull trees over 30" DBH will not be harvested or felled unless they pose a safety hazard.
- (2) Foresters will designate for wildlife and legacy retention, on average, and if present, approximately one large, live tree per 160 acres. The designated tree should exhibit "old growth" characteristics including declining growth, flat tops or large diameter. These trees will be identified and designated during the course of pre-harvest activities and should be retained in abiotically favored locations to achieve maximum use by wildlife species (Clark 2002, Irwin 2000, Underwood et al. 2010). These trees will be identified and designated during the course of pre-harvest activities.
- (3) Unevenage Silviculture: A primary landowner management objective is to grow larger trees. This objective is attained by using unevenage treatments, by thinning poorer performers, and favoring the retention of healthy, vigorous trees in post-harvest stands.
- (4) Evenage Silviculture: Application of variable retention harvest strategies will provide future large, old legacy trees within the Habitat Retention Areas (HRAs) in young forests..
- (5) Snag and Green Cull guidelines: Adherence to these guidelines will also help maintain or enhance recruitment of older and large trees in the forests.
- (6) Designated Wildlife Tree guidelines: Adherence to these guidelines will also help maintain or enhance recruitment of older and large trees in the forests.
- (7) Firewood Harvesting guidelines: Adherence to these guidelines will also help maintain or enhance recruitment of older and large trees in the forests.
- (8) Hardwoods. In addition to management of hardwoods described in Section 4.5.3, hardwoods that exhibit tree form and structure described under Section 4.4.2, Item (2) above, may be designated as legacy trees.

4.4.3 *Old and Large Legacy Tree Retention - Within Rehabilitation Treatments*

Specific to FSC® certification, in 2000, a site-specific approach was developed to identify and retain habitat structure in areas receiving rehabilitation treatments. During this site-specific assessment, the habitat elements available for retention are identified and prioritized. A general description of the kind of elements to be retained is included in the THP or site preparation agreements. In some areas the designation of additional specific individual trees (or other elements) is completed jointly by the forester, wildlife biologist and reforestation forester. Contractors hired to complete various timber harvesting and rehabilitation activities are closely supervised to ensure compliance with the retention guidelines in their agreement, timber harvesting document, and this habitat retention policy. To continue to maintain or enhance older forests and forest elements within rehabilitation treatments, we have developed the following guidelines. The guidelines described below may be modified as new information

becomes available and information is incorporated into management plans through an adaptive management process.

- (1) Focus on retention of large diameter trees with low economic value. These trees are valuable to wildlife because they possess various levels of decay or defect that provide habitat structure.
- (2) Prior to salvage harvest, the forester, wildlife biologist, and reforestation forester will work jointly to retaining suitable snags, LWD, large trees, and other legacy elements during harvest operations and subsequent site preparation activities. Site preparation agreements include specifications for the retention of snags and other habitat elements as stated above.
- (3) Rehabilitation treatments will establish trees on understocked areas thereby increasing the number of large diameter trees over the long term. Because of the variability of initial conditions prior to rehabilitation (e.g. tree stocking, site preparation method needed, brush species and density, and recent burn or old brush field) a site-specific approach will be used.

4.5 FOREST STRUCTURAL ELEMENTS

Management and monitoring of forest structural elements is conducted following a series of guidelines developed during previous SYPs, THPs, various permits acquired during management of the forests and most importantly to achieve the landowners' objectives. These guidelines for retention of forest structural elements apply to unevenage and evenage silvicultural treatments as well as in intermediate and rehabilitation treatments. The following management guidelines assess: (1) Snags and Green Culls, (2) Large Woody Debris, (3) Hardwoods, (4) Aspen, (5) Wildlife trees, (6) Variable Retention Silviculture and (7) Firewood Harvesting.

The management guidelines described are discussed during annual training sessions conducted by forestry and wildlife staff to familiarize field personnel with the benefits of, and procedures for identifying and retaining structural elements for wildlife. Further, all contractors are closely supervised to ensure that stated objectives are properly implemented.

4.5.1 *Snags and Green Culls*

Snags, green culls and large woody debris (LWD; fallen logs, stumps, root wads, etc.) serve a variety of ecosystem functions. Functions include nutrient cycling, providing substrate to support beneficial fungal (mycorrhiza) populations, and use as breeding and foraging habitat for over 100 species of vertebrate wildlife (and many more invertebrates which constitute a major food source for wildlife). Many snag-dependent bird species are highly insectivorous and have been shown to control pest populations. Carpenter ants, which inhabit snags, green culls and down woody debris, have also been shown to limit insect populations by feeding on the larvae of forest pest species (e.g. spruce bud worms). Some of these snags and green culls are among the largest diameter stems in the stands where they exist and typically represent "old growth" remnants.

Snag size and abundance needed to support various primary cavity nesters have been estimated at different levels of a maximum population potential (Thomas et al. 1979). It should be noted that guidelines did not rely on the model developed by Thomas et al. (1979) to set snag retention values, but simply used the model as one validation point indicating that our snag and green cull retention values are adequate to avoid significant adverse impacts to the environment. This approach greatly exceeds the 60-70% values for the maximum populations of these species (Thomas 1979). This level of snag and green cull retention is exemplary for private lands managed primarily for timber production and secondarily for wildlife and other resource values.

To continue to maintain or enhance snags and green culls within Red River Forests, in 2000 we formalized guidelines. The current guidelines described below may be modified as new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) In order to evaluate the abundance and distribution of snags, data concerning snags was initially collected during the 1996 inventory cruise. Since that time data regarding snags has been collected on an ongoing basis as part of the WBA inventory procedure.
- (2) Based on recommendations by California Department of Fish and Wildlife in 1999, an interim goal was established of 3.0 snags $\geq 16''$ DBH per acre of mature forest (CWHR size class 3 and above). Of these 3.0 snags per acre, 0.5 should be $\geq 20''$ DBH, 0.25 should be $\geq 24''$ DBH and 0.1 should be $\geq 30''$ DBH.
- (3) For the tracts that do not meet these goals, efforts to retain and recruit snags of the deficient size class will include a voluntary reduction in the intensity of sanitation/salvage operations and the physical identification of appropriate sized trees that are likely to become snags within the next 10 years.
- (4) All snags and green cull trees that do not contain at least 25% sound wood volume and do not pose a safety hazard or a potential hindrance to future access for initial attack of wildfire shall be retained.
- (5) Unevenaged silviculture: Unmerchantable large snags and green cull trees are retained to provide wildlife habitat. Areas that do not currently meet the snag retention objectives are identified and efforts are made to retain and recruit additional snags of the appropriate size class and species. These efforts take the form of discussions between the forester and wildlife biologist preparing the plan. The on-the-ground application relies on the supervision of field personnel. These on-the-ground efforts focus on applying conservative selection criteria with respect to marking. In other words, timber marking crews are instructed to bypass some merchantable trees exhibiting high quality habitat attributes because they may have a higher likelihood of becoming snags than vigorous and full-crowned trees.
- (6) Evenaged silviculture: Unmerchantable large snags and green cull trees are retained to provide wildlife habitat by retaining snags and green culls within both the harvest area and with specific Habitat Retention Areas (HRAs) at the rate of at least 0.2/acre, where they exist and do not hinder operations. Often, many more than 0.2 snags per acre are

retained because there are no benefits to falling snags that do not hinder operations. The forester, wildlife biologist and reforestation forester will work jointly to identify snag and green cull retention options during the preparation and implementation of evenage treatments.

- (7) Rehabilitation treatments are areas that are understocked due to insect attack and usually have numerous snags to select for retention. However, rehabilitation treatments in areas damaged by wildfire pose a special problem because sometimes snags are totally consumed by intense wildfires prior to any treatment. The long term availability of large trees for snag and green cull development is greatly improved by reforesting stands that have been left understocked due to wildfire or insect attack.
- (9) Prior to salvage harvesting, the forester, wildlife biologist, and reforestation forester jointly discuss retention of structural components like suitable snags, LWD, and large tree during harvest operations and subsequent site preparation activities. Site preparation contracts typically include specifications for the retention of snags and other habitat elements. To achieve these guidelines the following steps will be followed:
 - (a) To meet the forester objectives identify at the landscape scale all non-operational salvage areas including, but not limited to, economically and logistically limited areas. Also, identify all environmental and biological areas where salvage operations may be limited or not occur at all (e.g. WLPZs, seeps, springs, wildlife sites, archaeological sites).
 - (b) To meet the reforestation forester objectives identify at the landscape scale all non-operational and non-reforestation areas. Also, identify all areas where reforestation activities (e.g. biomass, fuel reduction or sub-soil ripping) may occur within salvage non-operational areas where retained stands or trees have been identified under item (a) above.
 - (c) To meet FSC® requirements, identify at the landscape scale,
 - i. Pre-wildfire existing snag and large woody debris density.
 - ii. Green tree retention for wildlife use and to accelerate seral stage development.
 - ii. FSC® standards and audit observations regarding salvage operations and wildlife considerations.
 - (d) Based on information identified under (a) through (c) above and consideration of structural components being retained at the landscape scale, if necessary, develop with the forester and reforestation forester stand level structural retention specifications and include these specifications in the appropriate contracts.
- (10) Watercourse and Lake Protection Zone: Large snags are not harvested or felled, hence recruited into WLPZs which also serve as wildlife habitat retention areas.

4.5.2 Large woody debris

In 1997, a forest management landowner objective was established to maintain or enhance wildlife habitat, including the retention of LWD. Data concerning size and abundance of LWD has been collected during cruises since 1997. This information has been gathered following harvest or thinning operations and is updated approximately every 10 years. Minimum thresholds for size are 10 inches diameter at the large end and 10 feet total length. All pieces meeting this minimum size requirement are estimated to the nearest diameter in inches and length in feet. Any piece that falls within the plot (1/50 acre or 16'-7" radius circle) is counted. It is anticipated that as snag numbers increase over time, LWD numbers will also increase as snags naturally fall. In addition, snag sizes will increase through retention efforts and subsequent LWD size should increase as well.

In general, management guidelines ensure forest management does not remove LWD during operations and, if possible, leaves LWD intact during all operations. To continue to maintain or enhance large woody debris within Red River Forests, in 2000 we further refined management guidelines. The current guidelines described below may be modified as new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) Retain 1 to 2 pieces per acre at least 10" in diameter and 10 feet long per acre. This retain should be focused in mature CWHR types (i.e. size class 3 or above) and efforts will be made to retain adequate levels in all CWHR types. A 5-year SYP update completed in 2010 indicates that these objectives were being met, especially in the larger (>24" diameter) size and advanced decay classes.
- (2) Avoiding LWD where it exists during operations involving tractors. Any LWD that does not contain sound sawlog or chip volume is currently left in place unless it needs to be removed for safety reasons.
- (3) Leaving LWD in place when piling material during rehabilitation or reforestation operations. As areas are reforested following regeneration harvest, LWD is and will be left intact where feasible. If LWD is professionally judged to be lacking in cleared areas, piled logs may be left unburned as allowed by the FPRs to provide habitat.
- (4) Where LWD is identified as deficient through inventory data, operators may be required to redistribute cull portions of logs that were skidded into landings during timber harvests.
- (5) During biomass operations, equipment limitations restrict the harvest of downed material to pieces <24"-26" and standing dead material <20"-22" in diameter.

4.5.3 Hardwoods

Native hardwoods typically occur as a component within some of the lower and middle elevations of Red River Forests. Hardwood primary species include: black oak, canyon live oak, dogwood, vine maple, big leaf maple, various willows, quaking aspen, alder, and cottonwood. The only hardwood species that is considered for commercial value is black oak, and commercial sawlog harvests of black oak have occurred rarely in the past. While commercial

oak harvests have taken place on limited occasions in the past over 30 years ago, none have occurred within the past 20 years and none are anticipated in the future.

All hardwoods are measured in the forest inventory design and data collection. The tree diameter and height is collected during cruises. Hardwoods in general and black oak in particular, can be very valuable for wildlife habitat. Black oaks can possess features such as dead limbs, broken tops, or other forms of decadence that provide structures, cavities, and hollow portions used by wildlife in addition to providing mast (acorns) valuable as wildlife forage. In some areas dead portions of otherwise sound black oaks can provide habitat for cavity dwelling wildlife in excess of what is provided by conifer snags within the same stand (Garrison et al. 1998). This is a crucial distinction and the proportion of defect in black oaks has been recorded since 2002 under the existing forest inventory design.

To continue to maintain or enhance hardwoods within Red River Forests, guidelines were developed. The current guidelines described below may be modified as new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) The management of hardwoods during timber harvesting is primarily a default retention of nearly all stems. Hardwoods may be felled if they pose a safety hazard during operations.
- (2) Efforts to limit the unauthorized removal of hardwoods include the regular inspection of all tracts. Illegal firewood cutting is actively discouraged through the posting of signs and the reporting of incidents to local law enforcement agencies.
- (3) Unevenage silviculture: The management of hardwoods is focused on the retention of all hardwood trees greater than 16" DBH, where feasible.
- (4) Evenage silviculture: In areas that are harvested using evenaged regeneration methods, mature oaks are specifically retained for wildlife habitat. If hardwoods occur in densities high enough to hinder operations, a representative 10% sample are individually marked for retention or retention specifications are stated in the THP. Where immature oaks are removed incidental to logging operations, rapid stump sprouting will ensure that oaks are recruited into stands. In areas treated with rehabilitation prescriptions, approximately 10% of the existing oaks or 1 to 2 oaks per acre are specified for retention as wildlife habitat in all site preparation and brush control agreements.
- (5) Biomass: There may be incidental removal of hardwoods during biomass operations but hardwoods are not targeted for removal. Harvest criteria in these types of operations include leaving hardwoods $\geq 20"$ DBH and retention of a substantial component of smaller hardwood stems for future recruitment of large stems. Also, because approximately 10% of all biomassed areas are left unthinned, the percent hardwood composition within these unthinned areas will remain essentially the same as the pre-harvest levels.

- (7) Rehabilitation: Approximately 5 to 10% of the area may be left untreated due to operational constraints and therefore, existing oaks are retained. Additionally, 1 to 2 oaks per acre are specified for retention as wildlife habitat in site preparation and release agreements.

4.5.3.1 Aspen

Native aspen (*Populus tremuloides*) can occur as its own unique habitat type or within several types of forest and non-forest habitats. Aspen can be an important habitat for many wildlife species. Several factors have contributed to an apparent decline in aspen stands including fire suppression, conifer encroachment, and browsing by domestic livestock and wild ungulates. Restoration of previously existing aspen stands can be achieved by removing conifers near existing aspen trees which reduces the competitive interactions for the light, water, and nutrients. Also, restoration can be enhanced by excluding domestic livestock and wild ungulates for a period of time following initial restoration to allow aspen stems to grow above browse height. When opportunities for aspen enhancement are consistent with overall goals and objectives the forester and wildlife biologist will propose restoration of aspen stands and seek the support of the California Department of Forestry and Fire Protection (CAL FIRE), CDFW, and water quality agencies.

4.5.4 Designated Wildlife Trees



Since 1993 WBA has been specifically identifying trees with special value to wildlife by either painting with a large “W” or attaching a metal “Designated Wildlife Tree” sign. Data concerning these trees had not been previously collected. Formal guidelines regarding data collection and mapping of Designated Wildlife Trees were established in 2001. When a tree is designated as a “wildlife tree” field personnel will collect information about the tree and the data will be entered into a database. This data will be tracked over time to determine how many wildlife trees are being specifically designated and what characteristics these trees possess. Criteria used for selecting wildlife trees and data collection and handling procedures are discussed during

annual field training sessions conducted by and with foresters and wildlife biologists. Trees retained for wildlife are those that exhibit beneficial habitat characteristics such as existing nest structures, cavities, large horizontal branches, large diameter boles, or indications of heart rot or other defect. While most trees possessing these characteristics are unmerchantable, some live green trees containing sound sawlog volume are retained. These otherwise sound trees may exhibit “old growth” characteristics such as declining vigor, flat tops, or diameters significantly larger than the surrounding stand average. When designating wildlife trees, tree species should be considered along with structural characteristics and spatial relationships. The emphasis should be on retaining pine trees where large pines or pine snags are currently scarce. Wildlife trees should be designated at rates necessary to achieve the snag recruitment guidelines specified above, while taking into consideration the contribution of all the other management guidelines that promote snags.

4.5.5 Variable Retention Silviculture

Since 2000, habitat retention areas are established when even-aged silviculture (clearcut) is proposed within a THP. Since the majority of unevenaged silviculture proposed on Red River Forests is either selection or group selection, habitat retention area establishment is designed to primarily contribute towards increasing forest habitat complexity. Secondly, habitat retention areas are also effective at retaining forest habitat elements, like wildlife trees, snags, large down logs and unique understory species including rare plants, that otherwise can be difficult to retain in the managed forest landscape.

While habitat retention areas are not the primary means how functional wildlife habitat will be retained in forest habitats, use of variable retention silviculture and intentional retention of complex forest structures have been shown to increase wildlife use in managed forests. Numerous observational studies have correlated relationships between complex forest structures and wildlife use in managed forests. Yet Rochelle (2005) highlighted that few studies have demonstrated the cause-and-effect relationships of retaining complex forest structures in managed forests. However, where cause-and-effect studies have been attempted, results have been positive. In early seral forests, biological monitoring of habitat retention stands has found that retention of pole, seedling, understory vegetation, and down woody debris is a key component in measured wildlife use (Stofel 1993, Kelsey 1994). Also, biological monitoring of new forestry stands have confirmed that small mammals (Sullivan and Sullivan 2001, Sullivan et al. 2001, Stofel 1993) and resident and neotropical song birds (Stofel 1993) benefit from the retention of these understory structures. In addition, regionally, Farber and Hewitt (2004) and Roloff and Liden (2009) found increased use of early seral habitats by neotropical and resident songbirds when habitat retention areas were retained within even-aged clearcut silviculture. Based on these results, habitat retention areas can enhance existing functional wildlife habitat. To continue to maintain or enhance habitat elements within Red River Forests we have developed the following guidelines. The guidelines described below may be modified as new information becomes available and information is incorporated into management plans through an adaptive management process.

- (1) Within even-aged clearcut silviculture prescriptions larger than 6 acres, 10% of the pre-harvest basal area shall be retained.
- (2) Habitat retention areas will be between 0.1 and 1.2 acres in size, although the targeted size of HRAs may vary depending on surrounding stand conditions such as the proportion of the tract scheduled for evenaged management over the planning horizon, the size of the evenaged regeneration unit, existing features within harvest units, and other wildlife considerations.

- (3) Habitat retention areas will be centered on existing habitat elements such as large snags, large green culls, poorly formed or defective trees, hardwoods, and LWD.
- (4) Native hardwood and understory vegetation will be retained, as available in pre-harvest conditions, to maintain or restore a diversity of species and forest structure.
- (5) Within habitat retention areas, trees of all sizes will be retained, although some removal of merchantable trees is allowed during the initial harvest.
- (6) Within habitat retention areas, following the initial harvest, some salvage of commercial trees may occur, as long as target levels for snag and other habitat element abundance is being approached.
- (7) Modifications may be proposed during the development of subsequent THPs based on site specific conditions. Modifications may include higher rates of retention, alternate spatial arrangement of retained elements, and other site specific adjustments.
- (8) Habitat retention harvest strategies are employed to assure that habitat structure is maintained in areas treated with evenage regeneration silvicultural prescriptions. In other words, plantations will be intermingled with unevenaged stands and distributed through space and time to ensure that a mosaic of various age and structure classes is present within planning watersheds.

4.6 MANAGEMENT SPECIFIC TO HIGH CONSERVATION VALUE

High Conservation Value Forests (HCVF) are defined by FSC® to be forests that contain environmental and social values of outstanding significance or critical importance at either a local or national level (ProForest 2003). Previously, a formal Special Management Area (SMA) policy was developed in 2001 and updated to a High Conservation Value Area (HCVA) in 2005. Current FSC® Standards require that forests be assessed to see if they contain any HCVFs (Indicator 9.1.a), collaborate with stakeholders or experts knowledgeable on HCVFs (Indicator 9.1.b), then develop management plans (Indicator 9.1.c), and monitor efforts to maintain or enhance the condition of HCVFs (Indicator 9.4.a).

4.6.1 HCVF Large Scale Ecosystem Assessment

Ecological regions are described and mapped based on associations of those environmental factors that directly or indirectly regulate structure and function of ecosystems (ECOMAP 1993, USDA 1997). Environmental factors include climate, physiography, water, geology, soils and hydrology that form potential natural communities. The United States Department of Agriculture (USDA) used these basic environmental factors in a hierarchical framework and mapped the Ecological Subregions of California (USDA 1997). The ecological regions were described in terms of geomorphology, lithology, soil taxa, vegetation, fauna, climate, surface water, disturbance regimes, land use and cultural ecology. Red River Forests lie within the Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow province of North America (ECOMAP 1993).

The World Wildlife Fund Global 2000 ecoregions have been designated by specific ecological based criteria. The criteria includes species richness, endemism, taxonomic uniqueness, extraordinary ecological phenomena and global rarity of major habitat types. Red River Forests lie within the World Wildlife Fund(WWF) Global 2000 ecoregions: Eastern Cascades (NA0512) and Sierra Nevada (NA0527).

Conservation International (CI) has designated Biodiversity Hotspots. Portions of Red River Forests lie within the California Floristic Province hotspot. The California Floristic Province is a sub-region of Mediterranean-type climate and has the high levels of plant endemism. The province includes unique species like giant sequoia, coastal redwood, and numerous listed species. Conservation International lists potential threats to the region as commercial farming, expansion of urban areas, pollution, and road construction. Red River Forests are managed, in part, by following native plant and invasive plant guidelines, which should minimize any potential impacts for native plant species identified by CI.

The International Union for Conservation of Nature (IUCN) and Smithsonian Institution have designated a Red List of ecosystems. To our knowledge, Red River Forests do not lie within any IUCN/Smithsonian Red List ecosystems. However, the ownerships do lie within the California Floristic Province (NA16g) also designated by Conservation International.

Greenpeace has identified Intact Forest Landscapes (IFL) as unbroken expanse of natural ecosystems within the zone of current forest extent, showing no signs of significant human activity, and large enough that all native biodiversity, including viable populations of wide-ranging species. Red River Forests lie within the forest zone outside of the IFL.

Based on these assessments of large-scale ecosystems and the native species that may occur within those ecosystems, the management of vegetation communities on Red River Forests does not appear likely to pose risk to those ecosystems. However, as described above, these forests lie within the California Floristic Province designated by Conservation International as a biodiversity hotspot. Red River Forests has management and monitoring plans in place to maintain or enhance native plant species. These plans are included THPs and are described in this document in Section 4.7 Native Plants, Section 4.7.1, Invasive and Noxious Plants and Appendix B.

4.6.2 HCVF assessment (Indicator 9.1.a)

The assessment and identification process for HCVFs (formerly referred to as Special Management Areas - SMAs) has been in place since 1998. This process was designed to evaluate the relative costs and benefits to the landowners of designating a particular area as a HCVF or employing a particular HCVF practice. Costs include foregone revenues from curtailing or delaying harvest in HCVF areas, retaining and recruiting HCVF elements and costs associated with management of these timbered and non-timbered areas. Benefits include increasing habitat and aesthetic values, maintenance of biological diversity, and safeguarding water quality. In 2000, the process of selecting HCVFs began and will continue until the normal 10 to 20-year timber harvesting entry cycle has been completed. In 2001, WBA began developing a list of candidate HCVFs to recommend for designation by the owners. Final approval of the

more obvious HCVFs designations by the landowners has occurred and additional recommended areas can be approved at any time.

4.6.2.1 *Information Sources*

The identification of HCVFs was completed using numerous information sources, including but not limited to, information documented in THPs, SYPs, state and federal wildlife databases, WBA forest inventory and the WBA GIS databases. Existing inventory information is used to classify forest stands using the CWHR (Mayer and Laudenslayer 1988). Stands are described by primary species, tree size and tree density. Non-forested areas such as montane riparian (MRI), wet meadows (WTM), annual grass (AGS), sagebrush (SGB), chaparral (MCH and MCP), juniper (JUN), blue oak/pine (BOP), and barren areas (BA) are also classified. If necessary, information from the WBA forest inventory including forest stand elements like snags, culls, large woody debris, and hardwood trees may be reviewed.

Additional sources of information include, but not limited to, observations of Special Status Species or unique vegetative communities. Several other sources of information are incorporated into the WBA database including current data from the California Natural Diversity Database (CNDDDB), local U.S. Forest Service data, and frequent contacts with adjacent landowners. These sources of information may also provide location of unique habitat types including, but not limited to, aspen stands, seeps, springs, and talus rock outcroppings, which may be suitable as HCVFs.

Watercourse and Lake Protection Zones are established to ensure riparian function is maintained and water quality is not adversely affected. Watercourses are mapped and classified the GIS and updated during the preparation of individual THPs. All watercourse crossings use a Best Management Practices (BMP) approach developed in conjunction with the DFG in a Master Streambed Alteration Agreement #R1-05-0497. In addition, aquatic surveys and water quality assessments and monitoring that are conducted as part of THP preparation and in specific locations known or suspected to support Special Status Species. Based on the existing information, either WLPZs or location of aquatic Special Status Species, may be suitable as HCVFs.

Significant historical and archeological sites have been and will continue to be documented in conjunction with a professional archeologist as part of THP development as required by the California Forest Practice Rules (FPR). These sites are mapped and stored in the GIS; they are also reported to CAL FIRE for inclusion in the California Historical Resources Information System (CHRIS). Archeological or historic sites that are reported in THPs and documented and maintained in GIS and database, may be suitable as HCVFs.

4.6.2.2 *HCVF Criteria*

The assessment of our forests, non-forested areas and sites of historical or cultural importance (archeological sites) were reviewed following the HCVF guidelines appropriate to the scale and intensity of forest management conducted on our forests. Consistent with the intent of HCVF, HCVFs were identified using the following criteria:

- (1) Stand or type met one or more of the values described as HCVF1 through 6 under Principle 9.
- (2) Stand or type met one or more data sources described under Indicator 9.1.a
- (3) Stand or types inhabited by Special Status Species. Examples of such areas include forest stands that have late seral characteristics or riparian areas that are occupied by special stands.
- (4) Forested areas, not primarily identified for their ecological characteristics, but identified regulatory, administrative and/or operational constraints that can be addressed by managing in a non-standard manner. Regulatory constraints include things such as WLPZs or protection of historic or archeological sites. Operational constraints include difficult terrain, limited road access, or geologically unstable areas. Administrative (voluntary) constraints consider aesthetic and/or recreational values as well as ecological considerations (i.e., stands currently containing relatively abundant late seral attributes, supporting listed species, or unique vegetative communities).
- (5) Forested areas that have or could develop late seral characteristics relatively quickly (within 25 to 50 years), have been and will continue to be designated so as to comprise approximately 1 to 3% of the timbered portion of Red River Forests. These forested areas and timber stands have and will be specifically designated as High Conservation Value Forests (HCVF) distributed among the Red River Forests. The management objectives for these HCVF will be to maintain and promote late seral forest habitats and values. Timber management may be conducted in some designated HCVFs, however, the harvesting guidelines will be tailored to meet the goals of the specific area.

For Red River Forests, there are a total of 3,533 HCVF acres identified in the WBA GIS. These acres represent 2.7% of Red River Forests and is within the goal of 1 to 3%.

4.6.3 HCVF Assessment Collaboration (Indicator 9.1.b)

In identifying HCVFs, a consultative process was used. The process included use of Registered Professional Foresters licensed by the State of California to provide objective and professional land management advice. These foresters have detailed knowledge of the forests from routine timber harvest field work, tree marking and timber cruising. The Chief Forester and Operations Forester should encourage staff to bring potential candidate HCVFs to their attention.

Foresters will consult with a wildlife biologist to present potential areas for consideration as candidate HCVFs. Currently, a wildlife biologist permitted by the State of California (#SC-7097) to handle wildlife species, permitted by U.S. Fish and Wildlife Service to handle endangered species (TE-834385-10, TE-20178A-0) and designated a Spotted Owl Expert (14 CCR 895) by the State of California, was consulted during the current review of HCVFs. The consultative process also included use of CDFW, Natural Diversity Database (CNDDDB) and Biogeographic Information and Observation System (BIOS) database. Proper identification of HCVFs is improved through consultation with CDFW and other state or federal agencies for listed species and sensitive habitats during the THP public comment period and review process. Areas identified for meadow restoration, restorative fencing, and aspen release projects are also subject to public

review because they are normally conducted as part of a THP or in conjunction with state or federal agencies. Additionally, as new scientific information or assessments are available, management, maintenance or monitoring of HCVF areas may be adapted to the new information.

4.6.4 HCVF Management Plans (Indicator 9.1.c)

FSC® Principle 9.3 states a management plan shall include and implement specific measures that ensure the maintenance or enhancement of the applicable conservation attributes consistent with the precautionary approach. These measures shall be specifically included in the publicly available management plan summary.

The established *High Conservation Value Practices* employed are specifically described in the in this document and THPs that are subject to public review and are required to disclose and mitigate any potentially significant adverse impacts to the environment. These include operations scheduled to occur in Late Successional Forest Stands, notification of downstream water users, notification of tribal representatives, presence of special status species, impacts to functional wildlife habitat, and cumulative impacts analyses that considers recreation, aesthetics, and watershed processes.

Sites inhabited by Special Status Species are monitored over time to determine occupancy, reproductive success, and habitat suitability. Management activities are designed to avoid adverse impacts to Special Status Species and maintain the habitat characteristics associated with these sites. All observational data pertaining to Special Status Species are annually provided to state and federal agencies for inclusion in their databases and also to adjacent private landowners if activities on neighboring lands could impact the site.

Management activities that may impact archeological or historically significant sites are developed in conjunction with CAL FIRE as part of the THP review process. During THP preparation, native tribal representatives are notified and input is solicited. Any concerns from tribal representatives are discussed and resolved prior to THP implementation.

4.6.4.1 HCV1 Management Guidelines - Non-timbered areas

These de facto HCVFs represent portions of Red River Forests that are maintained in a native condition and subject to natural succession. These areas will follow successional trajectories over time except that fire suppression may alter truly natural conditions (i.e., fire return intervals across the western U.S. are typically longer than those that occurred prior to European settlement). The commitment of Red River Forests to maintain these non-revenue producing portions of the ownership should be noted. Regulatory and Certification compliance costs exert pressure on landowners to dispose of such holdings; often with the unintended consequence of increased disturbance or environmental degradation associated with development or other more intensive land uses. Where necessary and feasible, desired seral stages and habitat conditions (i.e., natural vegetative communities and structure) may be maintained or restored using a variety of techniques including prescribed fire, managed grazing, and control of exotic or invasive species.

4.6.4.2 HCV3 Management Guidelines

For stands that meet the HCVF criteria for HCV3 or are candidates (SMA), management guidelines will be focused to maintain or enhance features associated with functional late seral habitats. Late seral habitats are naturally variable across the landscape encompassed by Red River Forests. Generally, late successional forests on the slopes of the Cascade and Sierra ranges are more densely stocked with timber, contain more snags and LWD, and achieve higher canopy closure than similarly aged forests found on the Modoc Plateau and east of the Sierra or Cascade crests. As such, the HCVF criteria may be adjusted based on geographic limitations (natural range of variability), site class, safety concerns in high use areas, or research that indicates alternative standards may be more appropriate.

Specific management criteria for these areas are outlined in “Timbered HCVF Management Guidelines” below. In summary, timber harvesting would only be conducted in the <20” DBH classes until the designated area grows into a specified condition. The guidelines would then allow for harvesting all size classes provided the post-harvest stand meets the minimum conditions detailed in the guidelines.

The designation of HCVFs and the management practices used in them are determined at the sole discretion of the landowner. They will be implemented to meet the overall long-term management goals of the ownership and are not considered “mitigation” to any regulatory permit, including the SYP or individual THPs.

For specific stands that have been identified as candidate (SMA) and designated timbered HCVFs will be managed using the following guidelines:

- Unit size variable up to 400 acres based on surrounding landscapes, connectivity, and unique characteristics of a particular HCV3.
- A variable range of 5 to 10 live trees per acre ≥ 24 ” DBH with between 2 and 6 live trees per acre ≥ 32 ” DBH and overstory canopy closure of between 40 and 85%.
- A variable number (0.5 to 2.0 per acre) of snags ≥ 24 ” DBH and at least 0.25 snags per acre that are >30 ” DBH.
- Entries no closer together than 15 years with targets of 20 to 30 years including salvage operations (catastrophic events would necessitate salvage in some cases).
- May use selection or sanitation/salvage silviculture so long as all minimum criteria listed above are met post harvest. Harvests should focus on removing smaller trees and retaining larger trees regardless of declining vigor.
- Maintain all LWD >18 ” diameter (large end) and $>20'$ long.
- In order to more quickly attain objectives, may thin from below appropriate trees that are <20 ” DBH prior to meeting criteria to promote growth into larger size classes and reduce the risk of catastrophic wildfire.

4.6.5 HCVF Monitoring Plans (Indicator 9.1.d)

The goal of the HCVF monitoring is to assess the implementation of the HCVF policy and effectiveness of plans to maintain or enhance HCVF objectives. Designated HCVFs have and will continue to be entered into a geographic information system and forest inventory. Designated HCVFs are and will be mapped as polygons that may include all or portions of one or more previously delineated timber stands or non-timber areas. Data concerning the resources within a HCVF will be analyzed by reviewing inventory data or data collected specifically for analysis as a HCVF. A general inventory of conditions within a HCVF may need to be conducted separately from standard cruising methods. This inventory would quantify existing conditions relative to tree diameter distribution, snags, indications of wildlife use such as cavities or existing nest structures, culls, LWD, species composition including conifers, shrub layers, and hardwoods, roads and road problems, any other relevant information (i.e., riparian zones or instream conditions if watercourses are present). A photo record may be used to depict these baseline conditions. High Conservation Value Forests may be re-inventoried on a regular basis (every 5 to 20 years) to quantify changes. Inventory intensity/rate will be dependent on level of management activities within a given HCVF and also on the number and size of areas to inventory and time needed to complete this work. A subset of HCVFs may be evaluated in any year. All inventory information for each HCVF will be recorded in a database with standardized fields. As monitoring and measurement of HCVFs and SMAs occur over time, based on these field measurements, changes in management objectives, uncertainty in interpretation of the FSC® standards, and possible FSC® standard changes or clarifications, HCVFs areas may be reevaluated and downgraded into SMAs (or no designation) and SMAs and other areas may be upgraded to HCVFs.

If necessary, monitoring will focus on inventory specifically focusing on snags, LWD, large trees, and degree of decadence. Monitoring will also focus on use of habitat elements by conducting point counts for birds, establishing camera monitoring stations, and conducting species specific surveys. Monitoring may include cooperative research to ensure objectives are being met and to assess wildlife use, biodiversity indicators, and habitat conditions within HCVFs or SMAs.

4.7 NATIVE PLANTS

Due to unique habitats and topographic and climatic conditions, a diverse native plant community is found within Red River Forests. In addition, many native plant species occur along seeps, springs, wet meadows and streams. In some cases, rare, threatened or endangered native plants may be found and are an important part of the natural biological diversity of Red River Forests. Since 2000, to ensure that proposed timber harvest plans and harvesting operations do not potentially cause significant adverse impacts to botanical resources, a comprehensive and detailed assessment and management plan is developed for each plan. A portion of the assessment includes collaboration with stakeholders including CDFW, Calflora and the California Native Plant Society (CNPS). In general, the management plan intends to avoid or minimize significant adverse impacts to botanical resources by assessing the intensity of the proposed operations, the response of specific native plant species to disturbance, the continued maintenance of naturally vegetated habitat types, and the rarity

of the potential native plant species present within the timber harvest plan area. Key features of the native plant management are highlighted below.

- (1) Timber harvest plan area is evaluated for known native plant occurrences or specific habitat types known to support various special status native plant species.
- (2) Potential habitat changes or disturbances occurring from the THP, if any, are reviewed relative to potentially occurring special status native plant species.
- (3) Where a THP may pose a risk of significant adverse impact to a particular special status native plant species, both extensive and focused intuitive searches for that species are conducted prior to timber management operations.
- (4) If special status species are detected, a site specific mitigation plan is developed with state agencies.
- (5) Based on a site specific mitigation plan, monitoring of a native plant species may occur.
- (6) A summary of native plant searches conducted is submitted to state agencies for each individual THP.

4.7.1 *Invasive and Noxious Plants*

The overall goal of the invasive and noxious plant programs is to reduce the risk of introduction, establishment, and spread of invasive and noxious weeds. To achieve these goals, the objectives of the program include: (1) Education and training of forest management personnel in specific species identification and recognition for early detection, (2) Assessments of specific species locations, (3) Physical, biological, or chemical control of specific species, (4) Monitoring effectiveness in achieving desired objectives.

To achieve these goals and objectives, the invasive and noxious plant program is designed to support existing county programs that coordinate county-wide control under the California Food and Agricultural Code (7272(b)) as well as an internal integrated pest management program. Management is conducted in cooperation with the Modoc County Weed Management Area, Shasta County Weed Management Area, Siskiyou County Weed Management Area, and Plumas-Sierra Noxious Weed Management Group which coordinates county-wide control for Plumas and Sierra counties. In addition, the invasive species policy incorporates an integrated pest management program, which guides the control of specific species. The integrated program may use silvicultural, chemical, manual, mechanical, prescribed fire, and biological tools to control or eradicate invasive and noxious plants. A comprehensive and detailed Invasive and Noxious Plant Management Plan is described in Appendix B.

5.0 MONITORING

Monitoring of forest, biological and watershed resources is guided by the "Monitoring of Forest and Biological Resources of Red River Forests " in Appendix D. The various monitoring programs described in Appendix D, provide information to help evaluate the effectiveness of maintaining or enhancing forest, biological and watershed resources on Red River Forests. The

monitoring programs also provide information to evaluate the forest management plans and operations.

Monitoring for wildlife values is conducted using a variety of methods and at a variety of ecological scales. The monitoring and subsequent adaptive occurs at three primary scales: (1) Landscape scale, (2) Stand scale and (3) Species scale. Due to the large number of individual species and habitats it is not economically feasible to monitor all the species or habitats. The various monitoring efforts or scientific studies which have been completed or are currently ongoing are not intended to completely study each species or specific habitat type. The goal is to validate the existing information in a hierarchical format. The validation will begin with reviews of regional literature. If necessary, monitoring will provide better information than previously known regarding the presence, distribution and habitat requisites of species, or the cause-and-effect relationship between forest management activities and selected species or their habitats: The hierarchical format is as follows:

Hierarchical Scale of Monitoring Types		
(1)	Regional Literature:	Monitoring which describes the regional information and scientific underpinnings of the forest, biological or watershed resource.
(2)	Presence or Absence:	Monitoring to determine the presence of a resource or species.
(3)	Implementation:	Monitoring which measures implemented management plans, as an example, measuring THP mitigation measures or best management practices.
(4)	Effectiveness:	Monitoring of whether a particular mitigation measure or best management practices is effective in achieving designed goal or objective.
(5)	Correlational:	A form of validation monitoring, used to validate whether previous Regional information or scientific underpinnings of species presence or habitat use is correct.
(6)	Cause-and-effect:	A form of validation monitoring, to explicitly test correlational information, typically in a before-after-control-treatment (BACI) study design.

Significant efforts will be made to conduct many of these monitoring efforts and studies with various regulatory agencies, in the belief that participation by stakeholders builds mutual understanding in the study design, the data collected and the analysis of the data. Results can then help evaluate the effectiveness of any mitigation measures and uses the results in an adaptive management context to develop future THPs.

5.1 STATISTICAL AND BIOLOGICAL RELEVANCE

Typically, due to relatively small sample sizes and lack of controls for both dependent and independent variables, statistically rigorous testing of forest and biological resource management assumptions is difficult. However, working with resource agencies and refining specific resource management questions can improve scientific study designs so that spurious results are limited. Both statistical and biological relevance of the scientific question should always be reviewed and the resulting acceptable level of scientific uncertainty should be described in study proposals.

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APPENDIX A RED RIVER FORESTS – HCVF (2021)

HCVF Code	HCVF Type¹	HCVF (acres)
HCV1	Forests or areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).	0
HCV2	Forests or areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.	0
HCV3	Forests or areas that are in or contain rare, threatened or endangered ecosystems.	1,304
HCV4	Forests or areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).	1,875
HCV5	Forests or areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).	0
HCV6	Forests or areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).	354
	Total Area Classified (Acres)	3,533

^[1] High Conservation Values should be classified following the numbering system given in the ProForest High Conservation Value Forest Toolkit (2003) available at www.ProForest.net or at www.wwf.org

APPENDIX B Invasive and Noxious Plant Management Plan



INVASIVE SPECIES POLICY

for

Lassen Forest & Red River Forests



July 2022

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1.0 Introduction

The W. M. Beaty & Associates, Inc. Invasive Species Policy is a program to assess the risk of invasive species, prioritize, and, as warranted, develop and implement a strategy to prevent or control invasive species. This is accomplished through assessment, management practices, control, and monitoring. Known populations of invasive species are present on the forest.

This policy has been developed and implemented in compliance with the FSC® Standard for Principle 6, Environmental Impact, and Principle 7, Management Plan. Additionally, the policy relies on and is supported by the associated Sustained Yield Plan (SYP).

The intent of this policy is to reduce the risk of introduction, establishment, and spread of invasive plant species. The goal of this risk reduction is to minimize the damages associated with invasive species to native ecosystems and to conserve the biological diversity found on the forest. By maximizing positive environmental impacts and minimizing adverse environmental impacts resulting from forest management operations, the damages to water resources, soils, landscapes, and unique and fragile ecosystems from invasive species can be minimized.

A noxious weed is any species of plant that the California State Department of Food and Agriculture has determined to be "troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate" (CDFA section 5004 Oct. 2015).

(http://ca.regstoday.com/law/fac/ca.regstoday.com/laws/fac/calaw-fac_DIVISION4_PART1_CHAPTER1.aspx)

All noxious weeds are invasive and non-native; however, not all invasive or non-native weeds are noxious.

2.0 Assessment

A combination of methods is used to determine the extent of invasive species populations on the forest. W. M. Beaty & Associates, Inc. strives to provide education to foresters regarding detection of invasive species. Forestry personnel are expected to document field observations of invasive species and report these findings to the W. M. Beaty & Associates, Inc. Reforestation Department.

2.1 Education

Foresters will be trained in the identification of invasive species that are likely to occur on the forest. Reference information is contained in the W. M. Beaty & Associates, Inc. files and are made available to foresters. Additionally, foresters are encouraged to participate in training courses related to invasive species. The following sources are used to aid in the identification and recognition of invasive species known or likely to occur within the forest.

- All Weed XID CD (purchase from Cal-IPC website)

- CA-California Invasive Plant Council. <http://www.cal-ipc.org/>
- CA-California Weed Management Areas. <https://www.cdfa.ca.gov/plant/index.html>
- CA-CalPhotos. <http://calphotos.berkeley.edu/>
- CA-CalWeed Database
- CA-Encycloweedea (CDFA). <https://www.cdfa.ca.gov/plant/index.html>
- California Department of Food and Agriculture, Integrated Pest Control, Weeds Alphabetical by Scientific Name:
http://www.cdfa.ca.gov/phpps/ipc/weedinfo/winfo_list-synonyms.htm
- California Invasive Plant Council (Cal-IPC). <http://www.cal-ipc.org/>
- California Invasive Plant Council: California Invasive Plant Inventory Database:
<http://www.cal-ipc.org/ip/inventory/weedlist.php>
- CA-Practical Guidebook for Invasive Aquatic Identification & Control.
<http://www.sfei.org/nis/NISguidebooklowres.pdf>
- CA-UC Davis Integrated Pest Management. <http://www.ipm.ucdavis.edu/>
- CA-UC Davis Weed Research and Information Center. <http://wric.ucdavis.edu/>
- CA-UC IPM Online Weed Photo Gallery.
http://ipm.ucanr.edu/PMG/weeds_intro.html
- Invasive Plants Field and Reference Guide: An Ecological Perspective of Plant Invaders of forests and Woodlands:
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<http://plants.usda.gov/java/noxious?rptType=State&statefips=06>
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<http://www.blm.gov/ca/st/en/fo/surprise/altweed.html>
- University of California, Agriculture and Natural Resources, UC IPM Online, Statewide Integrated Pest Management Program: How to Manage Pests, Exotic and Invasive Pests: <http://www.ipm.ucdavis.edu/EXOTIC/exoticpestsmenu.html>
- University of California, Growers Weed Identification Handbook.
- Weed Research and Information Center, UC Davis, <http://www.wric.ucdavis.edu/ca>.
<http://wric.ucdavis.edu/>

2.2 Detection

All forestry personnel should be vigilant in their observation of invasive species during field activities including: informal observations, tract inspection, screening sites during harvest planning and THP preparation, botanical searches/surveys, archaeological searches/surveys, monitoring activities, forest inventory cruising, timber marking, etc. Contract botanists may also be used for searches, field surveys, and identification when necessary. Foresters should communicate with adjacent landowners regarding known or potential invasive species occurrences. State listings of invasive species locations should be utilized as sources of information.

Known invasive species on the forest that were targeted with control methods or assessed in the previous 10 years include, but are not limited to:

Common Name	Scientific Name	CDFA Weed Rating	Cal-IPC Weed Rating	County	Tract
Dyer's woad	<i>Isatis tinctoria</i>	B	Mod	Modoc	Adin/Canby, Egg Lake, Glass Mountain
Hounds tongue	<i>Cynoglossum officinale</i>	B	Mod	Shasta	Pondosa, Jimmerson
Klamath weed	<i>Hypericum perforatum</i>	C	Mod	Shasta	Shasta
Musk thistle	<i>Carduus nutans</i>	A	Mod	Shasta	Pondosa
Purple loosestrife	<i>Lythrum salicaria</i>	B	High	Shasta	Pondosa
Scotch broom	<i>Cytisus scoparius</i>	C	High	Shasta	Shasta
Scotch thistle	<i>Onogordum acanthium ssp.</i>	A	High	Modoc	Adin Canby, Glass Mountain, Jimmerson
Spotted knapweed	<i>Centaurea maculosa</i>	A	High	Modoc	Adin/Canby, Glass Mountain, Jimmerson
Squarrose knapweed	<i>Centaurea squarrosa</i>	A	Mod	Modoc	Jimmerson, Pondosa
Tall whitetop (Perennial pepperweed)	<i>Lepidium latifolium</i>	A	High	Lassen	Harvey
Yellow star thistle	<i>Centaurea solstitialis</i>	C	High	Shasta	Pondosa, Shasta

2.3 Reporting

Foresters should report observations of invasive species to the Project Forester. Observations should include species name, descriptive location, legal description, mapped location, geographic positioning system (GPS) coordinates, extent, and photograph (if available). Known occurrences of invasive species will be added to the invasive species database as they are discovered. An invasive species layer has been developed and is maintained in the W. M. Beaty & Associates, Inc. geographic information system (GIS).

2.4 Weed Ratings

Methods to determine the degree of threat to native species and ecosystems include two widely recognized and accepted weed area rating systems.

California Department of Food and Agriculture (CDFA)

http://www.cdfa.ca.gov/phpps/ipc/weedinfo/winfo_list-synonyms.htm

The CDFA weed rating system includes five classes (A, B, C, D, or Q). The ratings are policy guidelines that indicate the most appropriate action to take against a pest under general circumstances. Local conditions may dictate more stringent actions at the discretion of the county agricultural commissioners, and the rating may change as circumstances change. The following are the definitions of the weed ratings:

- "A"** A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state because, by virtue of their

rating, they have been placed on the of Plant Health and Pest Prevention Services Director's list of organisms "detrimental to agriculture" in accordance with the FAC Sections 5261 and 6461. The only exception is for organisms accompanied by an approved CDFA or USDA live organism permit for contained exhibit or research purposes. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

- "B"** A pest of known economic or environmental detriment and, if present in California, it is of limited distribution. B-rated pests are eligible to enter the state if the receiving county has agreed to accept them. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in a nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.
- "C"** A pest of known economic or environmental detriment and, if present in California, it is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nursery stock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.
- "D"** An organism known to be of little or no economic or environmental detriment, to have an extremely low likelihood of weediness, or is known to be a parasite or predator. There is no state enforced action.
- "Q"** An organism or disorder suspected to be of economic or environmental detriment, but whose status is uncertain because of incomplete identification or inadequate information.

California Invasive Plant Council (Cal-IPC)

<http://www.cal-ipc.org/ip/inventory/weedlist.php>

The Cal-IPC weed rating includes three categories (High, Moderate, or Limited). The following are the definitions of the weed ratings:

- **High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
- **Moderate** – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- **Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Natural Resources Conservation Service (NRCS)

<http://plants.usda.gov/java/noxious?rptType=State&statefips=06>

The NRCS weed rating system relies on the CDFA rating system and includes additional qualifiers.

3.0 Management

Vectors to invasive species distribution include humans, animals, mulch, equipment, wind, vehicles, tools, etc. Numerous management practices are used to minimize the risk of invasive species establishment, growth, and spread. Practices to be considered and implemented by W. M. Beaty & Associates, Inc. include:

- Wash or clean equipment, vehicles, tools, and clothing of weed seeds prior to moving to or from sites with invasive species
 - Avoid seed mixes that contain potential invasive species
 - Use native logging slash
 - Use certified weed free seed
 - Use certified weed-free mulch (*more costly than native logging slash, not always 100% weed free, does not hold up as well as slash, supply is variable, and requires hauling in*)
 - Seed landings and other disturbed areas with native species
 - Alter silvicultural treatments
 - Effective forest monitoring and early detection
 - Invasive species identification training
-

4.0 Control

In prioritizing control of invasive species populations, W. M. Beaty & Associates, Inc. will consider the relative risk of invasive species infestations relative to other threats to the forest (e.g., fire, insects, disease, etc.). Control measures should match the scale of the infestation and the potential risks and/or actual impacts to native species and ecosystems. Where eradication is not feasible, efforts shall focus on control of existing populations to prevent further spread. Efforts should focus on controlling the seed bank (minimize new seed production and deplete existing seed). Where invasive species are extremely aggressive, mitigation, repair, and restoration of native species is often difficult, more costly, and sometimes impossible. Resources shall be allocated both to eradication and control of established invasive species populations when feasible and the prevention of new species occurrences.

W. M. Beaty & Associates, Inc. will use in-house foresters, outside contractors, and local government resources to control populations as appropriate. W. M. Beaty & Associates, Inc. has been a cooperator in the Lassen, Modoc, Plumas-Sierra, Shasta, and Siskiyou County weed management area (WMA) groups. These WMAs are cooperators in county-wide weed control under the California Food and Agricultural Code §7272(b). W. M. Beaty & Associates, Inc. maintains annual cooperative agreements (Weed Eradication Agreement Memorandum of Understanding) with Shasta and Modoc Counties to treat noxious weeds. The primary purpose of the WMAs is to cooperate on projects in order to seek and obtain funding. Unfortunately,

funding for the WMA Program has been eliminated from the CDFA budget as of June 30, 2011. The Terrestrial Noxious Weed Program and Weed Biological Control Programs at CDFA will also be eliminated on June 30, 2011.

Control methods to be considered include physical/cultural (mechanical and manual), chemical, thermal (prescribed fire), and biological (natural enemy). Non chemical control will be used where it can be effective.

Mechanical control will be used where feasible and may include mastication, hand pulling, and removal of seed heads along with bagging and disposal of collected material.

Chemical control will be used in compliance with the W. M. Beaty & Associates, Inc. Vegetation Management Policy and Pesticide Use Guidelines and Section WA.I.E.6, Chemical Contamination of the associated SYP. A pest control advisor (PCA) will prepare a pest control recommendation for all pesticide use. Herbicides that have been effectively used include: Accord XRT II (glyphosate), Milestone (a.i. aminopyralid), Transline (a.i. clopyrard), Garlon 4 (a.i. triclopyr), Weedone LV6 EC (2,4-D), etc. These herbicides are generally tank mixed with adjuvants and may include a water carrier. Herbicides are generally applied by hand crews equipped with backpack sprayers to control small populations.

5.0 Monitoring

Monitoring of control measures and management practices will be used to assess their effectiveness in preventing or controlling invasive species. The following types of monitoring will be used:

- Implementation monitoring will be conducted during and immediately after treatment to ensure the treatment was in compliance with the prescription.
- Effectiveness monitoring will be conducted the year following herbicide application to determine if the control measures produced satisfactory results.
- Trend monitoring will be used to determine if known populations of invasive species are expanding or new populations are occurring.

Monitoring may be conducted in conjunction with other monitoring activities described in Section WA.I.F, Monitoring Plan of the SYP. The metric of success is if existing populations are not increasing and new populations are controlled.

6.0 Invasive Species Photographs

The following invasive species occur or have the potential to occur on WBA managed lands.



Wavyleaf Thistle



Plumless Thistle



Canada Thistle



Scotch Thistle



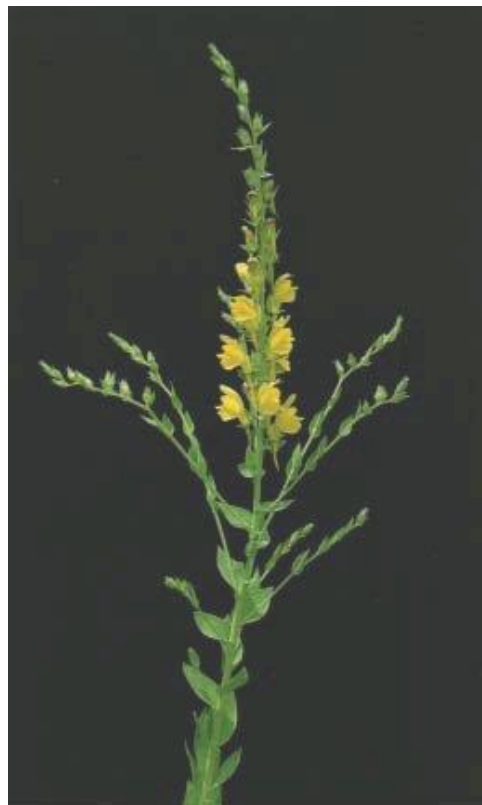
Yellowspine Thistle



Musk Thistle



Yellow Starthistle



Dalmatian Toadflax



Dyer's Woad



Dyer's Woad



Halogeton



Klamath Weed (St. Johnswort)



Hoary Cress



Leafy Spurge



Mediterranean Sage



Medusahead



Purple Loosestrife



Tall Whitetop (Perennial Pepperweed)



Diffuse Knapweed



Squarrose Knapweed



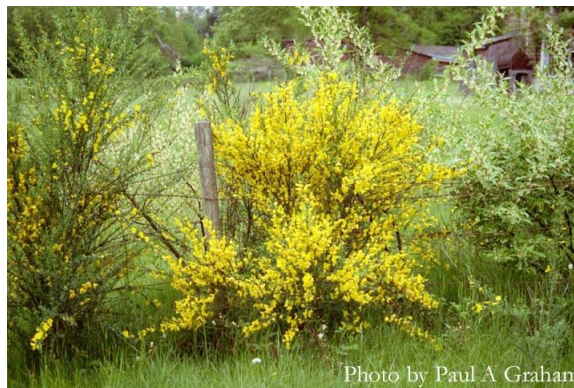
Spotted Knapweed



Russian Knapweed



Houndstongue



Scotch Broom



Common Crupina

APPENDIX C GRAZING MANAGEMENT PLAN

W.M. BEATY & ASSOCIATES, INC.
GRAZING MANAGEMENT POLICY
RED RIVER FORESTS

Background

Livestock grazing on Red River Forests (RRF) predates the acquisition of these properties by The Red River Lumber Company (TRRLC) and as such has been part of the custom, culture, and economic base in the northeastern region of California for well over 100 years. The timberlands and mountain meadows of this region serve as summer pasture and livestock operators were among the earliest settlers in the area.

In the early 1900's after private timberland holdings were established and the National Forests and Bureau of Land Management were created, a system of permitting livestock use was developed to manage grazing activities on what was and for the most part still is open range. A network of grazing allotments was formed around logical management units that evolved over time; these allotments often cover both private and federally managed lands. Grazing on federal land was, and still is authorized under long-term Grazing Permits while TRRLC permitted grazing under annual permits to the individual operators in each allotment. Permittees on RRF and SF still operate under an annual permitting process. Where grazing allotments include federally managed lands the appropriate agency has taken a custodial role over the allotment. As such, these agencies prepare annual operating plans that include turnout dates, stocking rates, animal use months (AUM's) and other applicable information for the entire allotment.

Monitoring

W.M. Beaty & Associates, Inc. (WBA) has been and will continue to work with the custodial agencies to monitor annual forage utilization using consistent methods to measure long-term trends on rangeland allotments. On most allotments key areas are being identified as appropriate locations for utilization transects to be established. Key areas are representative of the general range conditions and are capable of, and likely to show, a response to management actions. Grazing exclosures (4' X 4') are being constructed on key areas to aid in gauging annual forage production. Exclosures may periodically be relocated or mowed to reflect the grazed condition on allotments. Exclosures will serve as photo monitoring points at the end of each grazing season. Utilization data will be collected on key area transects by the permittee using the landscape appearance method. The WBA staff will use this same method to verify utilization on an annual basis. Permittees will provide WBA with utilization data collected on adjacent federally managed lands so that overall range trend and condition can be monitored. Where RRF comprise a minor percentage of an allotment and no key areas have been identified WBA will rely on adjacent transects. Utilization data, herd movement and range improvement forms will be provided to each permittee prior to each grazing season. These forms will be completed by the permittee and returned to WBA no later than November 30th of that years grazing. Data collected will be entered into a database by allotment.

Standards and Guidelines

In general the following standards will be used on rangeland allotments. These standards may be adjusted to achieve desired range conditions and/or to protect threatened and endangered species. Utilization standards will be applied to key areas on uplands, dry meadows, and moist meadows. Compliance with allowable use standards may require that cattle are moved or removed from key areas or entire units before standards are exceeded. Livestock will be removed from the allotments before the expiration of the grazing period if deemed necessary.

It is the permittee's responsibility to understand and comply with the allowable use standards. The permittee is required to move or remove livestock from areas before standards are exceeded.

Upland Areas

Allowable utilization of perennial herbaceous vegetation in the uplands is 50% of perennial rangeland vegetation that is in at least fair condition with stable trend and not associated with riparian zones. Decrease utilization to 0-49 percent on perennial vegetation where rangeland condition is less than fair condition or has a downward trend. Utilization is based on data collected using the landscape appearance method. Allowable utilization of current annual growth on browse species is 20%. Total utilization is the amount eaten or trampled by both wildlife and livestock.

Riparian Areas

Where necessary site potential and desired future condition will be defined for specific areas. Standards will be developed to achieve these conditions. Until site specific standards are in place, the following will be used to maintain or improve riparian condition. It is essential that the standards and guidelines are not exceeded.

Allow no salting or livestock supplements within ¼ mile of water developments, streams, or other riparian areas.

Bank Stability: At key use riparian benchmarks, cattle disturbance to streambanks and lakeshores will not exceed 20% of the measured reach. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. Apply management strategies to achieve at least 80 percent of naturally occurring streambank stability. Stability will be measured in linear feet by stream reach.

Stubble Height: Retain 4 to 6 inches stubble height on streamside vegetative biomass at end of the grazing season where capable. This standard may be modified depending upon stream condition and grazing system.

Utilization: Do not exceed 40 percent use of streamside herbaceous vegetation with no reduction in ground cover for streamside zones in good condition (utilization may exceed 40 percent when intensive systems are used to restore streamside zones to good condition or to maintain riparian zones already in good condition). For streamside zones in poor condition, utilization may be 0-25 percent until restored to fair condition. Riparian browse species (aspen and willow) will receive no more than 20% use on the current year's annual growth.

Irrigated Pastures

A few allotments are comprised of irrigated pasture. Permittees graze these pastures judiciously in the spring then move the majority of stock to rangeland allotments during the summer months. Livestock are brought back on to irrigated pasture after rangeland forage is utilized. Livestock are rotated off a pasture when an average stubble height of 4–6 inches is achieved. The most extensive irrigated pastures are located on the Home Ranch. In 2004 the Natural Resource Conservation Service developed a grazing management plan for the ranch. In addition to maintaining a 4-6 inch stubble height a rest and rotation schedule for the pastures was developed. Key areas of these pastures will be monitored by the permittee using either stubble height transects or photographic monitoring.

Threatened and Endangered Species

WBA is working with the United States Department of Agriculture (USDA) Forest Service to identify allotments where threatened or endangered (T&E) plant species may be present and potentially impacted by grazing activities. The WBA wildlife database and the California Department of Fish and Game (California Natural Diversity Database) are also checked for species that may be impacted by grazing. Where T&E species are known or are likely to occur within an allotment, site specific surveys of suitable habitat will be conducted by WBA to determine if that species present. If a T&E species is found to be present, WBA will work with the permittee to develop appropriate mitigations to avoid impacts to that species. These mitigations may include modifying the time of use, duration of use or exclusionary fencing.

Annual Meetings

Cooperative Meeting/Adjacent Landowner Coordination. Topics addressed include herb movement, range maintenance responsibilities, turn out restrictions, etc.

Related Documents

- Annual Grazing Plan
- Utilization Study Data (Landscape Appearance Method & form)

APPENDIX D MONITORING OF FOREST AND BIOLOGICAL RESOURCES

Monitoring of Forest and Biological Resources

Red River Forests



845 BUTTE ST. / P.O. BOX 990898
REDDING, CALIFORNIA 96099-0898
530-243-2783 / FAX 530-243-2900
WMBEATY.COM

1.0 Introduction

The overall objective guiding the forest management of W. M. Beaty & Associates (WBA) is to provide sustainable commercial timber production and maintain healthy forest ecosystems. Healthy forest ecosystems are capable of maintaining soil productivity and providing non-timber attributes such as clean water, wildlife habitat, livestock forage, and recreational opportunities. Providing sustainable commercial timber production and the amenities of a healthy forest ecosystem also meets the landowner's intent to support employment and long term regional economic vitality.

Forest and Biological Resources

Maintaining habitat over time for a diversity of native wildlife species is an important management goal. To meet this goal, it is the landowners objective to utilize the expertise of a WBA forestry and wildlife personnel. Operational guidelines to protect and improve habitat quality are incorporated into THPs.

Information needed to implement and monitor management activities which meet overall wildlife objectives, as well as timber management objectives, will be provided by incorporating habitat types and special habitat elements into resource inventories and land-based data management. Wildlife values will be maintained through the identification and retention of features and elements that provide high quality habitat for various species. Also, management plans for particular Threatened and Endangered (T&E) species are developed in cooperation with California Department of Fish & Game (DFG) and United States Fish & Wildlife Service (USFWS) to ensure against direct or indirect harm to protected wildlife and to promote the long-term maintenance of diverse habitats.

Watershed Resources

The long-term maintenance of healthy watersheds, including soils, water quality, riparian habitat, livestock forage, aesthetics and recreation, is also an important objective for the landowners. Appropriate forest management and erosion control practices will be utilized to sustain the long-term productivity of the soils as well as maintain and enhance water quality, riparian habitat, forage, aesthetics and recreation.

WBA has many different monitoring programs which provide information to evaluate the forest management plans and operations. This report describes WBAs forest, biological and watershed resources monitoring concepts, monitoring projects and adaptive management.

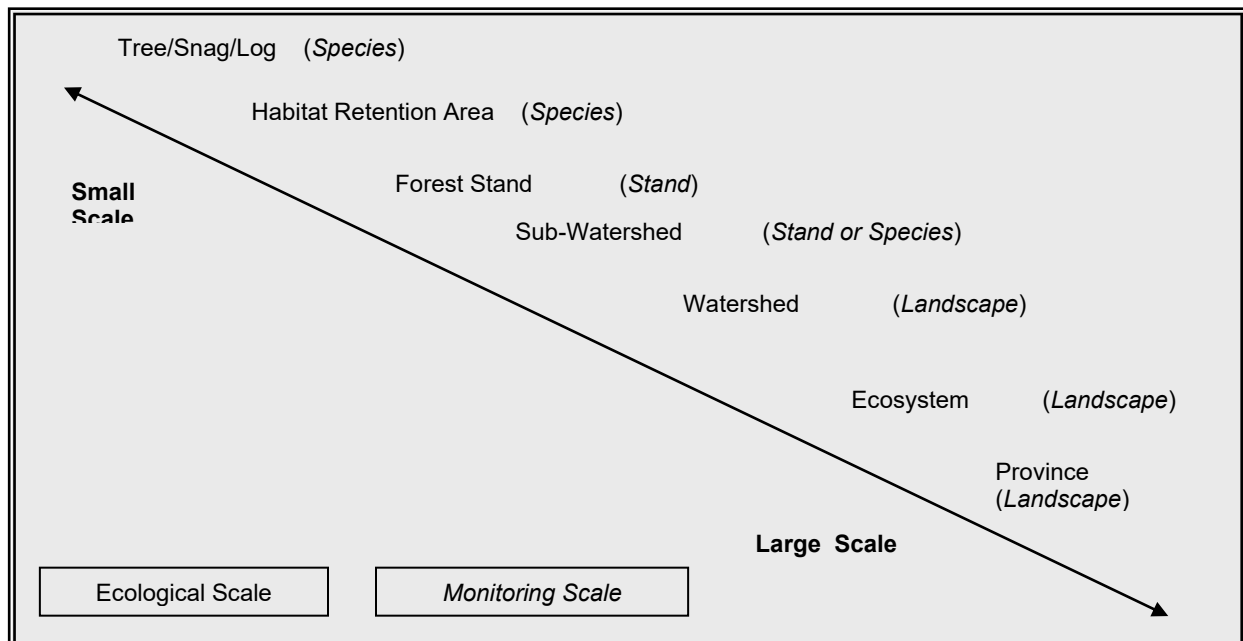
2.0 Forest, Biological and Watershed Monitoring Concepts

The WBA concept of forest, biological and watershed resource monitoring is designed around the recognition of the various ecological and temporal scales that occur within the forested landscape. It is well described that monitoring needs to occur at multiple ecological scales (Layton et al, 2003), yet recognize the temporal changes that occur at multiple ecological scales from both natural and manmade disturbances (White and Walker 1997).

2.1 Ecological Scale

There is no single forestland classification scheme that is better than another at monitoring for species or maintenance of biological diversity (Pregitzer and Goebel 2000). Many have supported a hierarchical approach to monitoring that mimics the biological organization of nature or scales (Pregitzer and Goebel 2000). The biological scales of nature follow a series of nested levels (Figure 1). Each of the lower scales are dependent on physical conditions in the larger scale for the development of ecological conditions (example: a tree is part of a stand which is located on a specific soil type). For the purposes of the WBA managed forest, biological and watershed resources, resources will be described, measured and monitored at the ecological region or sub region scale (i.e. landscape) and at various forest management scales (i.e. stand and species). Accordingly, a goal of WBA monitoring is to validate contributions of WBA managed forests at the various monitoring scales: Landscape, Stand and Species.

Figure 1 Biological organization of nature



2.2 Temporal Scale

Monitoring should also be done over a long enough time period to incorporate the range of environmental conditions allowing for valid estimates of management actions (White and Walker 1997). The appropriate time period may be as short as one year, as an example, when estimating response of species, if any, to specific auditory disturbances during the breeding season. However, multiple years of monitoring may be needed to identify responses, if any, to changes in habitat types by species.

2.3 Statistical and Biological Relevance

Typically, due to relatively small sample sizes and lack of controls for both dependent and independent variables, statistically rigorous testing of forest and biological resource management assumptions is difficult. However, working with resource agencies and refining specific resource management questions can improve scientific study designs so that spurious results are limited. Both statistical and biological relevance of the scientific question should always be reviewed and the resulting acceptable level of scientific uncertainty should be described in study proposals.

2.4 Refining Methods

Generally, the long-term nature of monitoring allows WBA to consider how operations are likely to affect the resources found on WBA managed forestlands over time, using the best available information. However, as new methods are developed and research provides clearer understanding of how wildlife species interact with their environments, WBA will incorporate the most appropriate techniques to ensure that no adverse impacts to wildlife occur as a result of land management activities.

3.0 Monitoring of various ecological scales

WBA has many different monitoring programs which provide information to help evaluate the effectiveness of maintaining or enhancing forest, biological and watershed resources on WBA managed forestlands. Due to the large number of individual species or habitats found on WBA managed forestlands it is not economically feasible to monitor all the species or habitats. The various monitoring efforts or scientific studies that WBA has completed or is currently conducting are not intended to completely study each species or specific habitat type. The goal is to validate the existing information in a hierarchical format. The validation will begin with reviews of regional literature. If necessary, WBA studies will provide better information than previously known regarding the presence, distribution and habitat requisites of species, or the cause-and-effect relationship between forest management activities and selected species or their habitats: The hierarchical format is as follows:

(1) Regional Literature: Monitoring which describes the regional information and scientific underpinnings of the forest, biological or watershed resource.

(2) Presence or Absence: Monitoring to determine the presence of a resource or species.

(3) Implementation: Monitoring which measures implemented management plans, as an example, measuring THP mitigation measures or best management practices.

(4) Effectiveness: Monitoring of whether a particular mitigation measure or best management practices is effective in achieving designed goal or objective.

(5) Correlational: A form of validation monitoring, used to validate whether previous regional information or scientific underpinnings of species presence or habitat use is correct.

(6) Cause-and-effect: A form of validation monitoring, to explicitly test correlational information, typically in a before-after-control-treatment (BACI) study design.

WBA attempts to conduct many of these monitoring efforts and studies with various regulatory agencies, in the belief that participation by stakeholders builds mutual understanding in the study design, the data collected and the analysis of the data. Then WBA evaluates the effectiveness of any mitigation measures and uses the results in an adaptive management context to develop future THPs.

3.1 Monitoring at the Landscape Scale

The monitoring and subsequent adaptive management that is designed also around the overall habitat based approach of the management plan and at multiple ecological scales:

(1) Landscape scale: Habitat known to provide shelter, forage or reproduction for a specific species.

(2) Stand scale: Habitat and elements known to provide shelter, forage or reproduction for a specific species at the stand scale .

(3) Species scale: Site-specific concerns regarding state or federally listed, state fully protected, Board of Forestry sensitive, and other special status species may be monitored, and adaptive management plans developed from results of monitoring.

We believe monitoring the habitat, habitat elements and then selected species at the appropriate ecological scale, provides the information necessary for Cal Fire and DFG to review the effectiveness of the planning measures described and implemented in subsequent THP's.

3.2 Monitoring at the Forest Stand Scale

Forest, biological and watershed monitoring at the forest stand scale is determined by the unique biophysical factors that occur at the ecosystem or landscape scale. At this monitoring scale, WBA recognizes that landscape scale factors need to be reviewed and considered when designing stand level monitoring. Also, at this scale, WBA considers how natural processes like

wild land fire have either created or limited monitoring opportunities at the forest stand scale. Monitoring topics that have been important include:

- (1) Diversity of habitat types and seral stages
- (2) Diversity of unique habitat types
- (3) Riparian habitats
- (4) Seep, Springs and small meadows
- (5) Small rock outcrops and talus slopes
- (6) Montane hardwood stands and hardwood species.
- (7) Unique species within specific habitat types

3.3 Monitoring guilds of species or individual species

These are some specific forest and biological monitoring that are designed for a specific guild of species or individual species. This summary is intended to describe the individual species being monitored, type of scientific study (See Section 3.0) and the level of scientific information and increased knowledge WBA believes is being gained from the monitoring. WBA has conducted the individual species monitoring, or in cooperation, with private research institutions, state, or federal wildlife agencies. Monitoring, either regulatory required or conducted voluntarily to assess current mitigation measures, is planned in a step-wise fashion to incrementally increase knowledge that leads to more informed forest, biological and watershed resource management decision making and subsequent adaptive management.

3.3.1 Monitoring of Aquatic Species

A wide variety of aquatic species occur within and adjacent to WBA managed forestlands. Riparian habitats that are found adjacent to seeps, springs, wetlands and watercourses are assessed during the preparation of THPs. Measures THPs use which may be monitored, but not limited to: (1) Retention of understory vegetation, (2) Retention of overstory vegetation, (3) Retention of down woody debris, (4) Retention of snags and wildlife trees, (5) None or limited disturbance of soils, (6) Revegetation of disturbed areas and (7) Buffering of riparian areas from application of herbicides or pesticides.

3.3.2 Monitoring of Native Plant Species

WBA managed forestlands also occur within a landscape of diverse native plant species. Native plants are typically present due to unique habitat, topographic and climatic conditions. Also many native plant species occur along seeps, springs, wet meadows and streams. Native plants are also an important part of the natural biological diversity. THPs that occur near any potentially unique habitat are assessed for the potential to support a rare native plant. Based

on the site specific information developed in the THP, survey and possible monitoring of native plant species may occur.

4.0 Adaptive Management

Adaptive management occurs through the monitoring of forest, biological and watershed resources and subsequent periodic review of monitoring results by WBA, CALFIRE, CDFW, various water quality agencies and the public. Adaptive management strategies have been developed in consultation with various resource agencies over a period of many years. These strategies and mitigation measures are generally focused on potential impacts from forest management activities including: limited operating periods, habitat buffer zones and retention of individual trees or elements. Specific monitoring has been and will continue to be developed with the resources agencies during THP development as needed and may consider:

1. HRA quantities, size and composition;
2. HCV location, size and composition;
3. large tree retention in snag deficient areas;
4. implementation of retention areas policy in biomass thinning units ;
5. implementation of hardwoods retention policy;
6. implementation of protection measures at water drafting sites where anadromous fisheries may be affected; and
7. implementation of protection measures for reducing sediment impacts from roads and crossings.

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APPENDIX E TIMBER ASSESSMENT



RED RIVER FORESTS, LLC

TIMBER ASSESSMENT

July 7, 2023

I. Timber Assessment

I.A. Current Inventory

I.A.1. Assessment Area

A vicinity map showing the RRF ownerships is included in Figure 1. In 2021 legal title was deeded from Red River Forests LLC to six different sub-LLCs, as shown on the map. The ownerships are further broken into separate tracts. Stand polygons of different land and timber types were originally delineated in the GIS for a previous timber assessment. They have been updated since that time, through the end of the year 2022, to account for harvests, natural disturbance, and property and land-type boundary adjustments. Table 1 shows the number of stand polygons and gross and net acres by land type for the ownership.

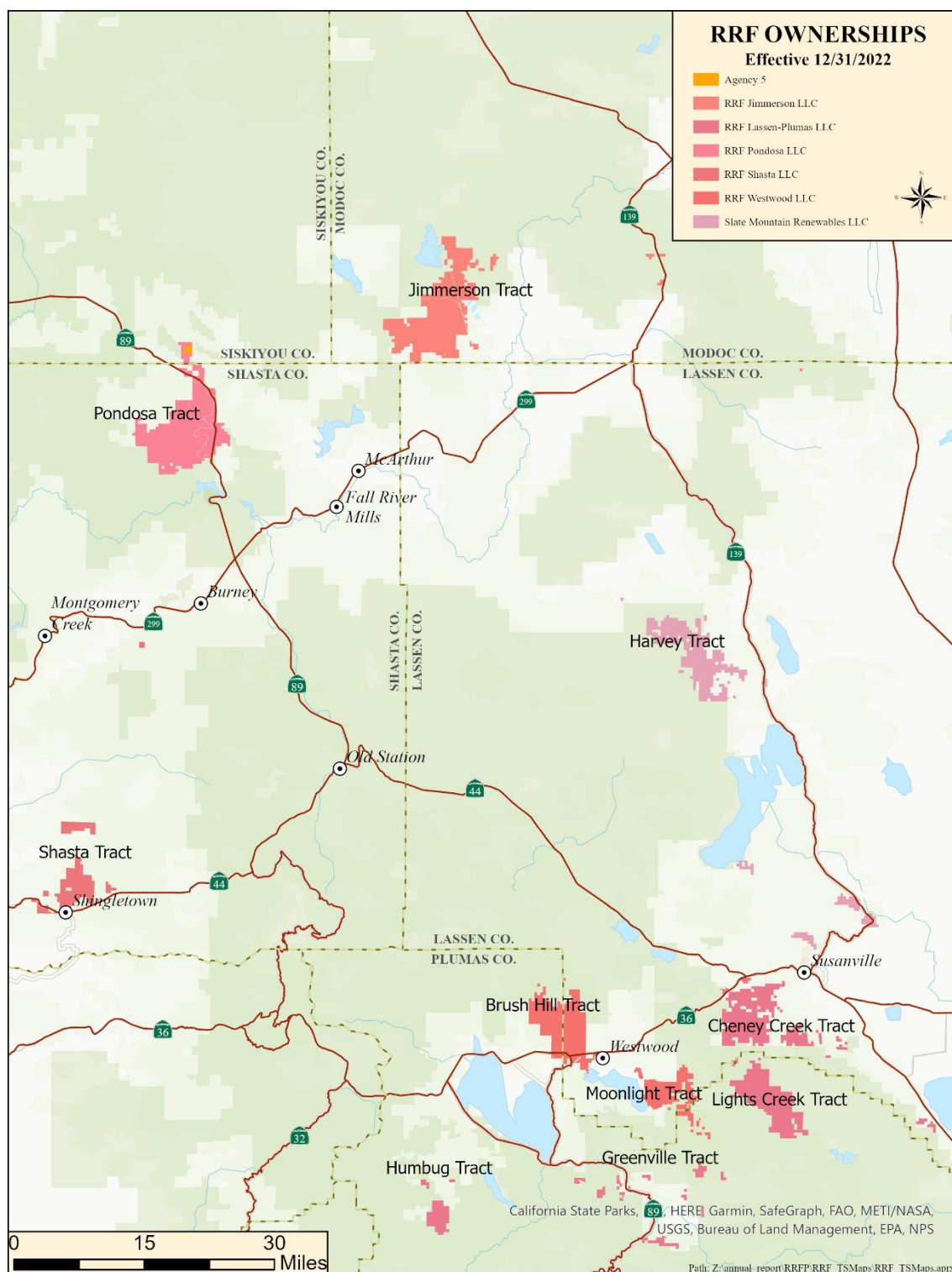
Table 1. Number of stand polygons and gross and net acres by land type.

Land Type	Number of Stands	Gross Acres	Net Acres
Stocked Timberland	795	69,725	69,284
Young Plantation	269	30,122	30,070
Non-stocked Timberland	144	20,715	20,647
Non-forest	407	13,737	13,600
Total	1,615	134,299	133,600

Stocked timberland is natural forest with at least 10% cover of commercial¹ conifer trees. Young plantation consists of planted stands less than 30 years old. Non-stocked timberland is land capable of growing timber but currently not stocked with trees and will likely be planted within three years. Non-forest types are areas of rock outcrop, brush, meadow, non-commercial species, water, or clearing for transportation or utility corridors. All polygons range in size from one to 1,017 acres and average 83 acres, and stocked, plantation, and non-stocked timberland stands range in size from four to 625 acres and average 98 acres. All acres are derived from ESRI ArcGIS, WGS 1984 Web Mercator Auxiliary Sphere.

¹ Group A species as per “commercial species” in 14 CCR 895.1.

Figure 1. Vicinity map of the RRF ownerships showing the ten major tracts.



Gross acres are reduced to net acres to account for the area that is not harvested due to the protection of Class I and II watercourse zones. Water courses are buffered in the GIS by the distances shown in Table 2 to quantify these protection areas. This is a way of estimating operable area in the model and does not relate to on-the-ground protection measures. The area covered by roads and landings were included in the cruise (plots could be mapped and cruised in these areas) and therefore included in the forested area.

Table 2. The distance from watercourse centerlines to create protection buffers.

Watercourse class	Watershed Type	
	Non-ASP	ASP
I	15	75
II	7	30

I.A.2. Inventory Data

The inventory design is in a state of transition, from a system of cruise plots on a systematic grid across all stocked timberland areas to a system based on stand polygons, strata, and sub-sampling. Prior to full implementation of the strata-based system, the older plots on the systematic grid are grown to date and used for the stands that have not been cruised with the new system. The older grown plots are adjusted based on a comparison of the old and the new system, where a direct comparison is available on 66 stands, each containing several plots. The old plots are adjusted with the results of the comparison, in Table 3, by using the adjustment factor multiplied by the trees per acre for each tree record in the inventory. These results are thought to be the result of several years of drought that has affected the growth (downward) and mortality (upward) of the more shade-tolerant species.

Table 3. The percentage difference between the new cruise and the old cruise, and the adjustment factors, by species, used to adjust the old data.

	PP	SP	DF	WF	IC
Percent difference	-5.1%	6.7%	10.4%	14.2%	8.7%
Adjustment factor	1.051	0.933	0.896	0.858	0.913

The new system stratifies all stands into approximately 30 different strata groups based on its location and habitat type (CWHR) and sub-samples a portion of the stands in each stratum, using a random selection process. The new system started in the year 2020, and since then approximately 1,500 plots in 159 stands have been cruised. All cruise plots are temporary survey points established with flagging. Plots are established by trained and supervised forest technicians working under a Registered Professional Forester.

Most plots are variable radius, with a basal area factor of 20, 28, or 40 depending on the predicted stand density. On each plot trees 6 inches in diameter at breast height (DBH) and larger are counted by prism sweep, and a one one-hundredth acre fixed radius plot is used for smaller trees. A minor number of plots in planted stands use fixed radius plots for all trees. All plot sizes are designed to obtain a sample of five to eight trees per plot. A sub-sample of plots are check-cruised for accuracy. All technicians use modern equipment and geo-referenced stand-level maps showing GPS plot locations. Cruisers record every tree that is at least one-inch DBH with its species code, DBH, and the percentage of each 16-foot

log that contains visible defect. On approximately one-third of all plots, data is also collected for total height and height to the crown base.

All selection harvest areas that were harvested after being sampled are adjusted in the inventory by reducing the trees per acre by the estimated number of trees harvested (using marking tallies). For even-aged harvest units, stand boundaries are adjusted so that new non-stocked stands are created from the harvest units. All plot data were grown through the 2022 growing year using FORSEE², or for planted stands less than 20 years old using CONIFERS (Ritchie 2010).

I.A.3. Missing Data Estimation

Approximately two-thirds of cruised trees are missing total height and live crown information. Missing total heights are filled in using custom procedures based on the work in the CACTOS STAG program (Biging et. Al., 1994). A linear regression on sampled heights for each DBH and species, with adjustments for basal area per acre and elevation, is used for each stand. When stand level samples are weak the pseudo-Bayesian method is used whereby measured heights from a larger area are used to supplement the local sample.

The missing live crown ratio is filled in using a ratio that is developed between observed live crown and predicted (based on an ownership-wide dataset of measured live crown by species). The ratio is stand and species-specific and is dependent on total height and basal area per acre. Crown width is not field measured. Crown width for all trees is filled in with estimates based on species and DBH, using a model and coefficients from a large dataset of measurements on nearby lands (Gill et al, 2000).

I.A.4. Volume and Defect

Scribner volume is generated in the FORSEE compiler using Wensel and Olsen tree taper equations to an eight-inch top diameter. Only commercial conifers that are greater than or equal to 11 inches DBH count for volume. Volume for the current inventory reports is net of log defect from the cruise.

I.A.5. Site Index

Base age 50 site index (Biging and Wensel 1984) is provided to the growth models for each species and each stand. Approximately 3,400 site trees were measured across the ownership during timber cruises dating back to 1995 and up until 2014. Site trees were selected from (or nearby) the cruise plot locations, and total height was recorded along with breast height age. A dominant species site index is first computed by averaging the site index for that species within each stand. This species is generally the most sampled and best suited to the area. A tract-based multiple regression was developed (using FPS and several additional environmental attributes by stand) to fill in Site_Phys for all stands without site index. Other species are estimated using the average difference from the Site_Phys for a wider area.

² Windows and Microsoft Access based distance independent individual tree growth and harvest simulator. Version 3 Build 29 (9/6/2017), by the California Growth and Yield Cooperative. Uses CACTOS growth equations (Wensel et al 1987).

Table 4. The number of measured site trees, by species and tract, for use in developing stand site index.

	PP	SP	DF	WF	IC	Total
Brush Hill	142	75	0	222	6	445
Cheney Creek	174	10	34	20	12	250
Greenville	45	9	121	28	1	204
Harvey	400	0	1	67	0	468
Humbug	2	2	8	23	0	35
Jimmerson	533	44	2	57	23	659
Lights Creek	39	10	0	28	3	80
Moonlight	49	18	27	26	5	125
Pondosa	228	72	346	195	43	884
Shasta	138	11	77	22	25	273
Total	1750	251	616	688	118	3423

An additional 260 trees were measured within planted stands using the height intercept method (Powers and Oliver 1978). This method uses a four-year internode length above DBH to convert to base-age 50 site index. For plantations that are too young to be measured, site index is assigned from the previous natural stand and then adjusted upward. Because site trees from the previous stand likely had some competitive stress above DBH (Newton and Hanson 1998), site index is increased by 15% to reflect the change in site productivity due to stocking and brush control and, in some cases, superior seed quality. The 15% level was chosen because plantation growth with this increased site index was a good match with measured plantation growth.

I.A.6. FORSEE Growth Calibration

I.A.6.a. Previous Calibration. W. M. Beaty foresters have been studying and calibrating tree growth on RRF for many years. Calibrations for the original SYP made use of CACTOS growth plots installed in 1979 and 1980. More re-measurement data on those same plots, plus additional growth results from 14 plots established around the year 2000 and re-measured in 2008 resulted in the calibration factors for the 2010 SYP update.

I.A.6.b. Growth Study 2020. Beginning in 2010 additional permanent growth plots were established, targeting areas not previously covered by the CACTOS plots, specifically in the Brush Hill, Cheney Creek, and Moonlight tracts. These plots and others were re-measured in 2019 and 2020. All plots use the same format, where all trees greater than 2 inches DBH are measured on a 1/40th-acre plot, greater than 5 inches DBH on a 1/10th-acre plot, and greater than 11 inches DBH on a 1/5th-acre plot. Plots established since the year 2000 use a three or four-plot cluster.

The objective of the growth study is to arrive at values with which to calibrate FORSEE and accurately predict growth, using the proportional adjustment page in the 'Configure' growth model section of the software. A subset of the above-mentioned plots was selected because they are on or close to RRF and are relatively evenly spread across the ownership. This includes 39 plots at 17 cluster locations, as shown on the map in Appendix A. Detailed methodology and results are shown in Appendix A. As a result of the growth study, several stand site indexes were adjusted downward, and a growth reduction factor of 90% of normal diameter and height growth is used for both updating cruise data for the current inventory and for all future projections for this assessment.

I.A.7. Current Inventory

Table 5 and 6 show some compiled inventory output for the ownerships combined, by species, for stocked timberland. The sampling error for total net volume is 1.1% at the 95% accuracy level. From the FORSEE compiler the periodic annual increment for net volume less mortality is 3.37%.

Table 5. Net thousand board foot volume and standard error for the ownership, by species.

	PP	SP	DF	WF	IC	LP	Total
MBF	340,672	53,062	160,221	150,706	45,583	636	750,881
St. Error	3,353	1,405	2,238	2,239	896	143	4,241

Table 6. Trees per acre, basal area per acre, and quadratic mean diameter for each species group.

Species Grp.	TPA	BA	QMD
PP	66	48	11.6
SP	4	5	14.8
DF	23	18	12.0
WF	49	21	8.8
IC	40	14	8.1
LP	0	0	10.5
Conifers	185	108	10.3
Hardwoods	21	8	8.0
Totals	206	115	10.1

I.B. Projection Methodology

I.B.1. Landowner Objectives

The RRF timber management objectives are long-standing and continue forward, as listed below:

- Provide an annual, sustained level of commercial timber to local area mills.
- Provide a stable annual revenue compatible with the landowner's expectations.
- Sustain or increase asset value over time through timberland acquisition, stand improvement, and compatible uses that provide income diversification.
- Provide for a healthy forest ecosystem, which maintains soil productivity and provides non-timber attributes such as clean water, wildlife habitat, livestock forage, aesthetic enjoyment, and recreational opportunities.

To meet RRF objectives, WBA foresters will use various intensities of uneven-aged and even aged silvicultural methods. Uneven-aged methods will be used predominantly. Even-aged methods will be used primarily where there are forest health issues or where there are areas of insufficient regeneration, where long term uneven-aged management is difficult to sustain.

Uneven-aged treatments will focus on creating or encouraging regeneration while keeping healthy trees of all age classes. To provide for adequate regeneration foresters will use their education, experience, and creativity to emulate small-scale disturbance resulting in a diversity of species, structure, and age classes, and they will take advantage of advanced regeneration and create individual tree, gap, and group openings. Treatments will be applied appropriately in various sites and conditions. In most cases

group openings will be site prepped and planted and the competing vegetation will be controlled. In some cases, density will be reduced aggressively to adjust species mix and stocking levels for better resiliency to future drought and climate change.

There are no processing facilities owned by RRF. Forest products to be harvested include mostly larger diameter sawlogs (minimum 8 inches small end diameter on 32-foot lengths) that are further processed into dimension lumber, studs, fencing, veneer, and other products. Smaller sawlogs, logs for export, poles, chip logs, fuel chips, and pulp chips may also be produced in some years and are minor in comparison.

I.B.2. Existing Plantation Projection

For the purposes of projection, all planted stands 20 years old or less, despite having been sampled or not, are assigned to one of eight plantation data sets. All plantations 10 years old and less (15,334 acres) are assigned to the 5-year age class, and 11 to 20-year-old stands (10,189 acres) are assigned to the 15-year age class of one of the eight types. Which data set type depends on the stand's location (species mix and site quality).

These data sets were carefully constructed using the CONIFERS young stand growth model up to 30 years of age and then with FORSEE after that. Input from various plantation sampling results was used to build the yield data sets (see the last two paragraphs of Appendix A). These stands are also used for future yield sets as discussed in section I.B.6.

I.B.3. Ingrowth

The number, size, and species composition of the ingrowth that is added during the simulation projections is derived from an assessment of small trees in the current inventory and then adjusted based on our estimates of future management results. For all ingrowth areas the trees are set at 4-inches in diameter and have a 20-year grow-up interval after the initial ingrowth call. Total height is 15 feet for pines and fir and 13 feet for other species, and live crown ratio is 60 percent.

The number of trees added to existing stand data varies by treatment type, as described in I.B.4, and by forest type. The number of ingrowth trees that are added during model simulation is different for westside types and eastside types. This is because, in general, based on inventory database queries there is less regeneration in the pine-dominated eastside types.

The species mix of the ingrowth that is added to a stand during simulation depends on which area the stand is in. There are 15 regeneration areas that have been identified across the ownership. Each stand in the inventory belongs to one of these areas. In anticipation of our efforts to encourage shade-intolerant species, slightly more ponderosa pine and Douglas-fir are added than exist in the current inventory. This adjustment has been made for some of the forest types in areas where group openings are likely to be established.

I.B.4. Silvicultural Treatments

All projections are built within the FORSEE batch processing mode using VB Script. Output is provided in 10-year periods with harvests occurring at the midpoint of periods. The planning horizon length is 10 periods. This is a stand-specific model where each stand is projected independently and stand identities are maintained throughout the model.

Most of the silvicultural treatments listed below have different harvest intensities for larger trees (referred to as Large Tree hereafter). The size of Large Tree is described by the diameter at breast height (DBH) in inches. What constitutes a large tree depends on the tract, as follows:

- 32 inches for the Brush Hill and Moonlight tracts
- 30 inches for the Pondosa, Shasta, Lights Creek, Greenville, and Humbug tracts
- 28 inches for the Jimmerson and Cheney Creek tracts
- 26 inches for the Harvey tract

I.B.4.a. Clearcut. This treatment involves the removal of a stand in one harvest. This will likely occur on stands with health problems, or where uneven-aged methods do not conform with the objectives of 14 CCR 933.

I.B.4.a.1 Variable Retention. Since 2000 and the implementation of the RRF SYP (00-002), a goal of variable retention has been to enhance the current and future forest stand structure and create more complex wildlife habitat. To achieve this goal, an objective of variable retention is to retain aggregate or dispersed Habitat Retention Areas (HRAs) within clearcut silviculture. These HRA's are effective as retaining forest habitat elements like wildlife trees, snags, large down woody debris and unique understory species including rare plants. Specifically, where clearcut silviculture is proposed, the implementation of variable retention will incorporate the following guidelines:

- (1) Approximately 1 to 3% of each area treated with clearcut silviculture will be designated for retention.
- (2) HRAs will be between 0.1 and 1.2 acres in size and will take into consideration landscape habitat conditions, size of the clearcut unit in acres and existing habitat features within unit.
- (3) When practical, clearcuts shall be irregularly shaped and variable in size to mimic natural patterns and features in the landscape.
- (4) Forest disease and pests will be considered in meeting retention guidelines.
- (5) Specifics will be described in each timber harvest plan and the standards in 14 CCR 933.1(a) will be met.

To a limited degree, any of the seed tree or shelterwood steps, or the rehabilitation of understocked areas prescription, may be used and will comply with the rules specific to those treatments. For the purposes of this assessment, these treatments along with clearcut and variable retention will be considered clearcut.

The model simulation removes all trees from 95% of the area. Five percent of the area that is clearcut is withheld from harvest, continues to grow, and is available for harvest after a five-period lock (50 years). This functionality is explained in more detail in Section I.C.2.

I.B.4.b. Fuelbreak. The Fuelbreak prescription will be applied in areas commonly used by the public, such as along main roads. Creating defensible space is the objective in this treatment, where all trees greater than or equal to Large Tree are harvested, followed by a thinning of all trees two inches DBH to Large Tree, down to a residual stocking of 50 square feet basal area per acre (BA). Ingrowth of 40 TPA, or 30 on eastside types, are added every 20 years after a successful harvest. This is repeated on average every 10 years in some areas, and on average every 20 years in other areas. Actual entry cycle length may vary from 7 to 13 years for the 10-year areas, and from 17 to 23 years in the 20-year areas.

I.B.4.c. Selection on a 10-Year Entry. This treatment is most often used in lower elevation areas where brush is prevalent and more likely to inhibit conifer establishment and growth, and in other areas that are more difficult to regenerate naturally. Trees are removed individually or in small groups sized from .25 acres to 2.5 acres. Trees of different age classes are retained, and provision is made for adequate regeneration. Specifics will be detailed in individual THPs. Post-harvest stocking standards shall meet or exceed standards in 14 CCR 933.2(a)(2).

This section refers to both the selection and the group selection systems. It also covers the much less likely use of the Transition, Commercial Thinning, or Sanitation-salvage methods. Details will be provided in individual THPs and post-harvest stocking will meet or exceed the standards specified in the rules for the specific silvicultural method.

The computer simulation harvests all commercial conifers greater than or equal to Large Tree plus 7 (for example 37 inches DBH on the Shasta Tract). If there is more than 10 BA of hardwoods, then 25% of the BA 6 inches DBH and larger of hardwoods is thinned. For commercial conifers 12 DBH to Large Tree plus 7, a maximum of 28% of the BA for these trees is thinned using a diminution quotient of 1.2 on two-inch DBH classes, with a priority on the lowest live crown ratio trees. The harvest intensity is reduced if required to leave a minimum of 75 BA of conifers, or higher for habitat stands (see section III.B. below). Trees from Large Tree to Large Tree plus 7 are harvested 25% more, and white fir trees are harvested 30% more, compared to the overall percentage, while keeping the total intensity constant.

Twenty TPA, or 15 for eastside types, is added every 10 years after successful harvests, except for habitat stands which receive 13 TPA, or 10 TPA for eastside types. If a stand does not meet the minimum post-harvest BA requirements, then no harvest is applied. This treatment is repeated on average every 10 years, but actual entry cycle length may vary from 7 to 13 years.

Although group openings may amount to as much as 30% of harvest areas, most harvests contain less group openings as a percent of the total area. FORSEE does not have a provision to model group openings with selection. Both the growth calibration (as in Appendix A) and ingrowth settings (as in II.B.3) were developed with the assumption that there would be some group openings.

I.B.4.d. Selection on a 20-Year Entry. This treatment is the same as the Selection on a 10-Year Entry, except the maximum harvest is 56% instead of 28%, as described above, and 25 TPA, or 20 TPA eastside, is added as ingrowth every 20 years. This treatment is repeated on average every 20 years starting in either the first period or the second period, but actual entry cycle length may vary from 17 to 23 years.

I.B.4.e. Variable Density Selection. This treatment will be used on most of the ownership to represent both selection and group selection systems. Trees are removed individually or in small groups sized from .25 acres to 2.5 acres. Trees of different age classes are retained, and provision is made for adequate regeneration. Specifics will be detailed in individual THPs. Post-harvest stocking standards shall meet or exceed standards in 14 CCR 933.2(a)(2).

For the computer simulation, harvests are conducted according to the following priority:

- (1) If there is more than 10 BA of hardwoods, cut 50% of the BA of hardwoods 6 DBH and larger.
- (2) Cut all merchantable conifers greater than or equal to Large Tree plus 7.
- (3) Cut white fir trees greater than or equal to Large Tree.
- (4) Thin other commercial conifers greater than or equal to Large Tree to Large Tree plus 7 leaving at least 20% BA of these trees.
- (5) Cut white fir trees 12 DBH to Large Tree using a diminution quotient of 1.3 on two-inch DBH classes leaving a minimum of 30% of these trees.
- (6) Cut other commercial conifers 12 DBH to Large Tree using a diminution quotient of 1.3 on two-inch DBH classes leaving the minimum requirements.

The modeled minimum post-harvest BA of all commercial conifers is 75, 100, or 125, and a minimum of 40 BA in commercial conifers greater than or equal to 12 DBH. If at any point the residual requirements are not met after harvest, the remaining steps are skipped, and the current harvest is adjusted to meet the post-harvest requirements. Forty ingrowth trees are added, or 30 for eastside types, after harvest. This treatment is repeated on average every 20 years, but actual entry cycle length may vary from 17 to 23 years.

Although group openings may amount to as much as 30% of harvest areas, most harvests contain less group openings as a percent of the total area. FORSEE does not have a provision to model group openings with selection. Both the growth calibration and ingrowth settings were developed with the assumption that there will be some group openings.

I.B.4.f. Reforestation. The current stands in the non-stocked timberland condition are converted to plantation in the first period. Stands transition to one of the eight plantation yield sets depending on its location, then are available to be clearcut after reaching 5 MBF/acre of volume, or for the variable density selection regime with thinning treatments in even or odd periods.

I.B.5. The Yield Table

A yield table is built from all the growth and yield projections for use with the harvest scheduler. The yield table includes the following: the stand number, several stand attributes, MBF inventory, MBF harvest, and financial metrics for each period. The yield table has one record (one line in the file) for each stand, each period, and each of the potential silvicultural treatments that could be applied to that stand. The stand attributes in the yield table are period mid-point values.

A simple growth projection is included in the yield table for all stands. It does not include any treatment or any ingrowth. This projection is not used often but is included in the yield table for the following purposes:

- For high conservation value forest types that receive no treatment
- For portions of stands that are clearcut that remain as habitat retention
- For any stand that is not harvested by the harvest scheduler (not common)

Because FORSEE growth equations were built from data on second growth managed forests it does not perform well for extended periods without harvests. For the grow-only projection the growth is calibrated downward when stands reach BA thresholds during simulation. If a stand basal area in any period is above 205 the growth is calibrated to 40% of normal growth, and to 20% of normal growth above 230. These calibration values result in stand volume per acre maximums that match our experience and expectations.

Stands are identified if they are within THP areas to be logged within the next two or three years, so that they are scheduled in the first period with the planned silviculture.

I.B.6. Future Plantations

Any stand or portion of a stand that is clearcut transitions to one of eight future plantation types depending on its location. Table 7 shows the planted species mix, planted trees per acre, base age 50 site index, and percent of ownership area for these eight future plantation types. All are assumed to be free of competing vegetation and optimally spaced. The CONIFERS growth model was used to grow these types for the first 30 years. CONIFERS tree tables are then re-formatted and simulated in FORSEE for the balance of the planning horizon.

Table 7. The planted species mix, planted trees per acre, base age 50 site index, and percent of ownership area.

Type	Percent by Species					TPA	SI 50	Owner
	PP	SP	DF	WF	IC			Pcnt
1	90%	0%	0%	5%	5%	135	58	17
2	85%	0%	0%	8%	8%	135	65	11
3	90%	0%	0%	5%	5%	135	79	5
4	55%	6%	24%	12%	4%	178	67	17
5	55%	4%	24%	12%	6%	178	80	27
6	55%	4%	24%	12%	6%	178	92	9
7	45%	4%	24%	24%	4%	178	87	6
8	48%	4%	4%	31%	13%	167	83	8

These yields will be achieved through high standards for reforestation. W. M. Beaty & Associates maintains a reforestation forester position responsible for new plantation establishment. This position carries the Pest Control Advisor License, obtains continuing education, and provides site and time specific treatment recommendations. Modern best practices in vegetation control, planting, seed stock, and spacing control are used to re-establish diverse, healthy, and vigorous forests. Improved seed stock is used where available along with cone collection for locally adapted seed.

There are three yield sets built for each plantation type. The first is a grow only projection, which is the same as that described in Section I.B.5, except that there is a commercial thinning at age 45, reducing BA to 75. The other two projections are Variable Density Selection treatments as described above, with the post-harvest residual density set at 75 BA in either even or odd periods.

I.B.7. California Wildlife Habitat Relationship (CWHR)

CWHR types (Mayer and Laudenslayer 1988) are computed and tracked for each stand and each period by FORSEE and CONIFERS. The FORSEE CWHR calculations are based on the program developed by Greenwood and Eng (Greenwood and Eng 1993). All Ponderosa Pine cover types are changed to Eastside Pine (EPN) if the stand average precipitation is less than 35 inches or if the area is clearly within the geographic boundaries for EPN. All mixed conifer cover types are Sierra Mixed Conifer (SMC).

I.C. Harvest Scheduling

I.C.1. Woodstock

The Woodstock program from Remsoft Spatial Planning System (version 2022.01. Copyright Remsoft Inc. 1993-2015, www.Remsoft.com) is used to keep track of how and when to harvest stands or portions of stands in each period. An optimizing linear programming model is designed within Woodstock with the objective of maximizing harvest volume in all periods. There are limits to the model's ability to optimize, however, due to the limited silvicultural options for each stand and the various constraints specified in the model.

At the start of execution, Woodstock will schedule all pre-planned activities that are loaded into the "LpSchedule" file. This file contains a list of stands with the first period planned action (treatment). To schedule clearcuts within current THPs and other areas that have a higher likelihood of being clearcut, several stands are pre-selected for clearcut in period one. The LpSchedule file also contains listings for 20-year selection entry stands in geographic proximity to each other, scheduled to start in either the first or second period, so that the resulting schedule is grouped into operational areas.

Next the model will continue scheduling harvesting actions in each period subject to the constraints, such as operability limits. Operability limits use landscape themes, which are codes that give each stand an identity and provide control for several functions within Woodstock. The four themes are as follows:

- Theme 1: a code for the yield set containing the silvicultural treatment projection.
- Theme 2: the operability code holding the type of stand and its treatment options.
- Theme 3: the future plantation type
- Theme 4: the stand number

Operability limits use Theme 2 to control the treatment options that are available to each stand or portion of a stand. Another operability constraint is that stands must have at least 5 MBF per acre to be clearcut. Theme 3 directs Woodstock to transition acres to a new plantation type after clearcut. After a clearcut 95% of the acres are transitioned to one of the three possible new plantation yield sets as described in Section I.B.6. Five percent of the acres remains as the current type and no harvest is allowed for five periods.

Model constraints are ownership-wide, model-wide limits, and include a non-declining inventory, even flow (with a given variance allowed) of total harvest volume, and even flow (with variance) and maximum limit on clearcut acres. Table 8 shows the number of stands and acres associated with wildlife constrained stands.

Table 8. The number of stand polygons and acres with minimum post-harvest retention requirements.

Harvest Constraint	Num. Stands	Acres
Maintain a minimum of 80 sq. ft. BA/acre	26	967
Maintain a minimum of 100 sq. ft. BA/acre	2	149
Maintain a minimum of 120 sq. ft. BA/acre	7	1,325
Maintain a minimum of 150 sq. ft. BA/acre	4	421
No harvest - High Conservation Value	4	217

I.D. Timber Assessment Results

As shown in Figures 2, 3, and 4, harvest scheduling results indicate a forest with increasing density over time as indicated by average BA, QMD, and volume. While foresters are aggressively trying to lower densities through the harvests of stocked timberland in anticipation of warmer and dryer conditions in the future, the overall conditions show increasing density due to the growth of the many plantations. The values in Figure 4 are based on the before harvest condition at the period midpoint.

Figure 2. Average ownership-wide basal area per acre over time.

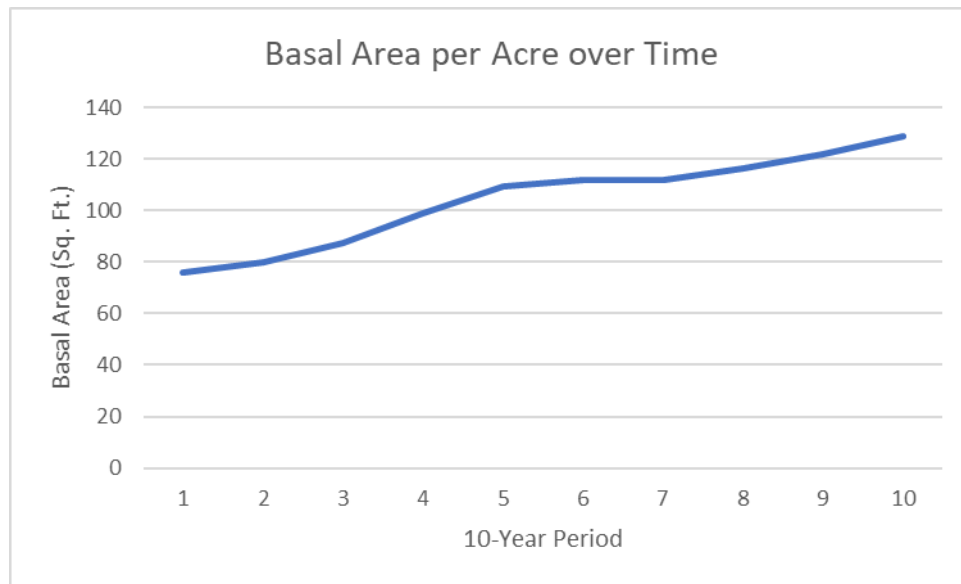


Figure 3. Average ownership-wide quadratic mean diameter over time.

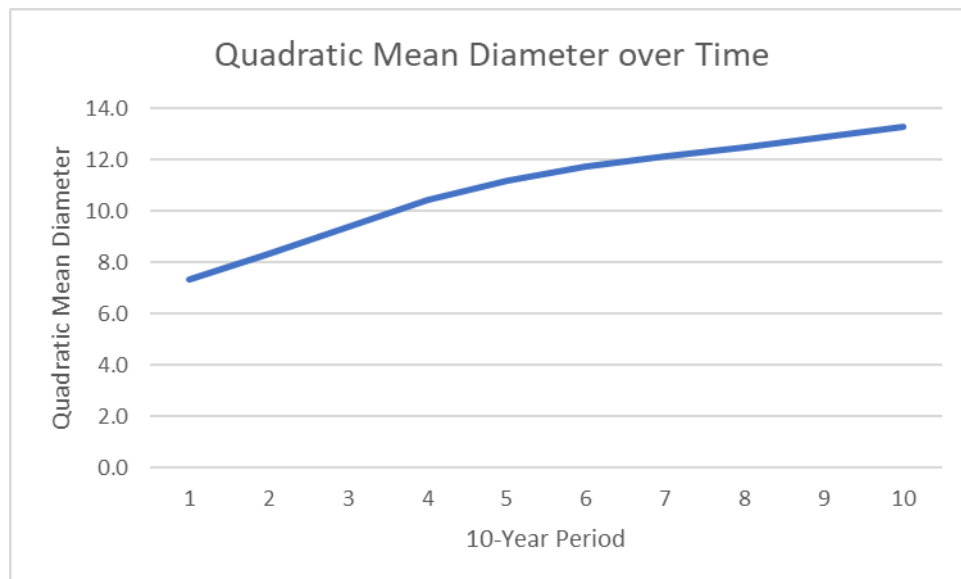
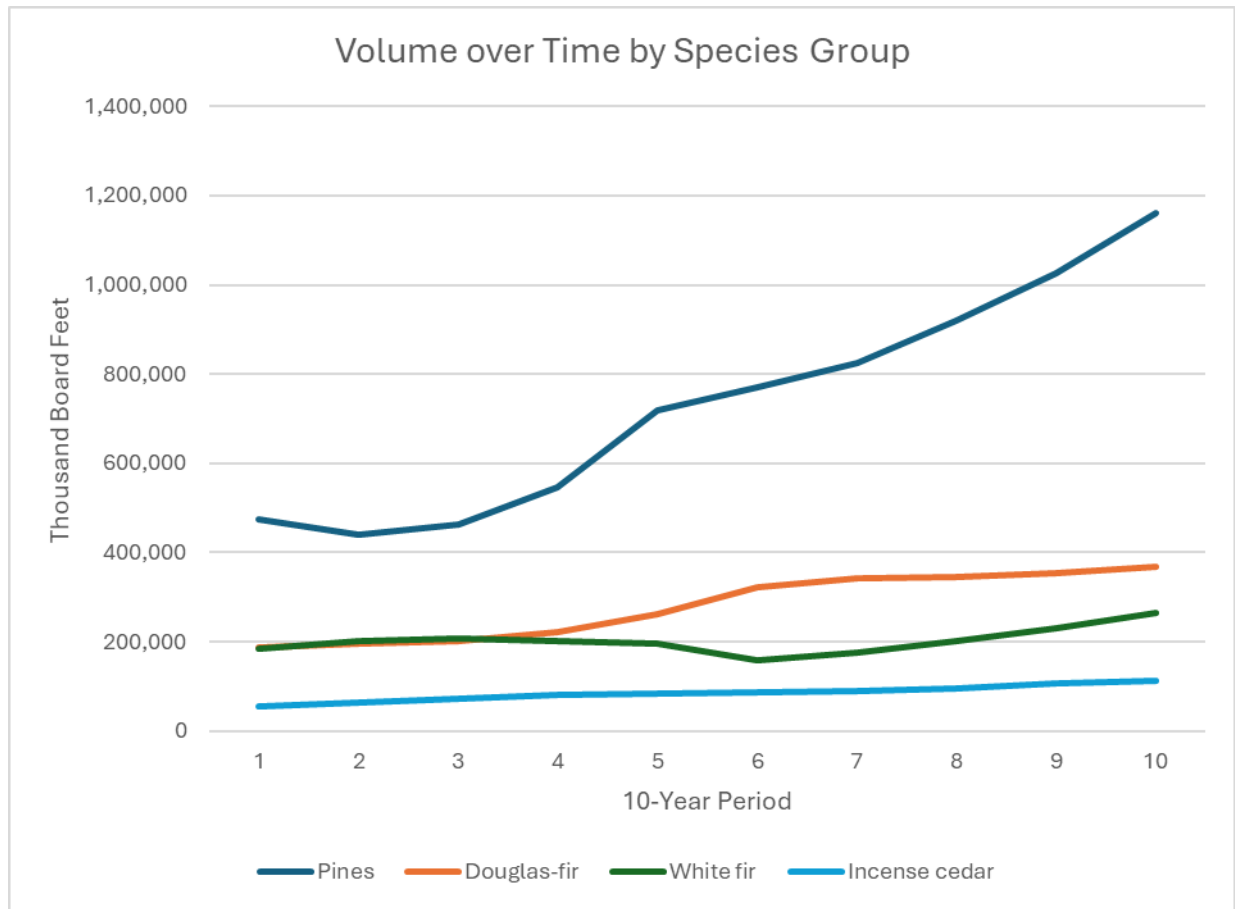


Figure 4. Standing inventory levels for pine species, Douglas-fir, white fir, and incense cedar over time.



Tables 9 and 10 show volume and acres by silvicultural group and period for the ownership. Total inventory is 900,372 MBF prior to activities at the midpoint of the first period, is relatively stable for the first 3 10-year periods and increases steadily thereafter as the plantations mature. The long-term sustained yield will be achieved by implementing the spirit of this model. Foresters will proceed in a workmanlike manner to meet or exceed the harvest and growth, forest health, and regeneration levels that are assumed in this model.

Table 9. Thousand board foot harvest volume by silvicultural treatment category and 10-year period.

Silviculture	1	2	3	4	5	6	7	8	9	10
Selection	227,934	228,706	223,524	197,406	299,276	330,118	337,602	330,517	334,204	333,132
Clearcut	40,137	39,364	44,546	71,771	83,681	52,839	45,356	52,440	48,754	49,825
Total Harvest	268,070	268,070	268,070	269,177	382,957	382,957	382,957	382,957	382,957	382,957

Table 10. Acres treated by silvicultural category and 10-year period.

Silviculture	1	2	3	4	5	6	7	8	9	10
Selection	39,755	34,682	41,880	39,137	56,071	68,494	55,605	51,074	52,525	48,765
Clearcut	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000

Reforestation	20,595	0	0	0	0	0	0	0	0	0
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II. Consideration of Other Forest Values

Foresters shall select silvicultural systems, operating methods, and procedures which substantially lessen significant adverse impacts on the environment, and which best achieve long-term, maximum sustained production of forest products. This shall be done while protecting soil, air, fish and wildlife, and water resources from unreasonable degradation, and which evaluate and make allowance for values relating to range and forage resources, recreation and aesthetics, and regional economic vitality and employment.

II.A. Habitat Types and Elements

A wide variety of California Wildlife Habitat Relationship System (CWHR) diameter and crown closure classes are present creating a mosaic of habitat types within the RRF ownership. Because the ownership has been previously harvested under both uneven-aged and even-aged silviculture and subject to several large stand replacing wildfires, the variability of tree sizes within individual habitat types and across the landscape is high. However, the variability between habitat types across the ownership is lower than it would be in a fully regulated even-aged forest. Most of the habitat types are CWHR size class 3 and 4 with open to moderate crown closure. Although the average DBH in most types is between 10 and 26 inches, there is a wide range (from sapling to ≥ 40 -inch DBH) of individual tree sizes within most types.

In addition to retaining a mosaic of habitat types across the ownership, specific measures are implemented as part of THPs to retain important wildlife habitat elements within habitat types. Specifically, wildlife habitat elements are retained through: Species-Specific Habitat Types (Section III.B.), Watercourse and Lake Protection Zones (Section III.C.), Limited or No Harvest Areas (Section III.D.), Large and Wildlife Trees (Section III.F.), Snags and Large Woody Debris (Section III.G.) and Hardwoods (Section III.H.).

II.B. Species Specific Habitat Types

Several federal or state listed, Board of Forestry sensitive, Fish and Game Code fully protected, rare or non-listed species occur within the RRF ownership. Due to their status under federal or state laws or regulations, retention of species-specific habitat has been retained in previous RRF THPs and will be retained in future RRF THPs. Projections in the model have been constrained for the entire inventory stand where the species is represented to take into consideration these species-specific habitat types that are retained within THPs. To-date, a total of 43 inventory stands comprised of 3,079 acres have been identified by RPFs or WBA wildlife biologist(s). The post-harvest species-specific habitat retention in THPs is tailored as follows:

- (1) Legal status as either as federal or state listed, state candidate, sensitive, fully protected, rare or non-listed (FGC 3503.5) and,
- (2) Suitable habitat associations or tolerance to disturbance from forest management activities and,
- (3) Suitable habitat conditions and species occurrence at the specific site.

II.B.1 Federal or state listed, state candidate, sensitive or fully protected

Active Wildlife Site

These wildlife sites have been determined to be active based on direct observation of the RPF, the RPF designee, a wildlife biologist or detected using a remote camera or acoustic station. Also, at a minimum, a site may be determined to be active as defined under 14 CCR 895.1, Active Nest or continue to be active based on recommendations by either California Department of Fish and Wildlife (CDFW) or U.S. Fish and Wildlife Service (USFWS). Post-harvest habitat retention and disturbance measures for these species typically includes a: (1) No harvest site zone, (2) Limited harvest core area and (3) Critical period area (14 CCR 939.2, 939.3). The size of each of these zones or areas can vary by species, suitable habitat associations, site-specific habitat and tract level habitat conditions. These zones or areas are developed in consultation with either CDFW or USFWS and either proposed in the initial THP or amended into the THP. At a minimum, the den or nest site and all screening trees, perch trees, and replacement trees shall be left standing (14 CCR 939.2(d)) and all snags within these sites shall be left standing (14 CCR § 939.1).

Species-specific suitable habitat has been previously retained in RRF THPs for these federal or state listed, candidate, sensitive and fully protected species including: Northern spotted owl, Northern goshawk, bald eagle, Cascades frog, Sierra Nevada yellow-legged frog and foothill yellow-legged frog. Each site or habitat zone has been assigned a minimum basal area (BA) retention that provides either suitable denning, nesting or foraging habitat for the species that may not be otherwise retained within a mosaic of habitats at the tract scale. Previously, these values ranged from 80 BA up to 150 BA. Since future species-specific habitat stands are unknown and predicting new sensitive species is speculative, future species-specific habitat stands will be described in individual THPs. For the purposes of estimating projections in the model, these inventory stands are treated in the model with a less aggressive selection harvest, retaining larger trees, and are not harvested to less than the preferred BA post-harvest retention described in this Section.

Historical or Currently Inactive Wildlife Site

These wildlife sites have been determined to be historical or inactive based on either lack of direct observations, a significant change in habitat has occurred since original use (e.g. nest tree has been blown down), or the site may be determined to be inactive as defined under 14 CCR 895.1, Active Nest or based on recommendations by either California Department of Fish and Wildlife (CDFW) or U.S. Fish and Wildlife Service (USFWS). Even if the site is determined to be historical or inactive, at no time shall the original den or nest site or any trees containing raptor nests be harvested.

II.B.2 Rare or Non-listed species

Active Wildlife Site

These wildlife sites have been determined to be active based on direct observation of the RPF, the RPF designee, a wildlife biologist or detected using a remote camera or acoustic station. Non-listed species den or nest sites shall be tailored to suitable habitat associations, tolerance to disturbance from forest management activities and species occurrence at the site. The species-specific habitat retention shall be designed by the RPF or a designee in consultation with a wildlife biologist to avoid or minimize potential effects of timber operations on the den or nest site. At a minimum, the den or nest site and all screening trees, perch trees, and replacement trees shall be left standing (14 CCR 939.2(d)) and all snags

within these sites shall be left standing (14 CCR § 939.1). Additional post-harvest habitat retention and disturbance measures for these species may also include, depending on the species habitat associations, tolerance to disturbance and occurrence at the site; (1) No harvest site zone, (2) Limited harvest core area and (3) Critical period area. These retention areas are either proposed in the initial THP or amended into the THP.

Species-specific suitable habitat has been previously retained in RRF THPs for these rare or non-listed species including California spotted owl, barred owl, great horned owl, Cooper's hawk, sharp-shinned hawk, and red-tailed hawk. Each site or habitat area has been assigned a minimum basal area (BA) retention that provides either suitable denning, nesting or foraging habitat for the species that may not be otherwise retained within a mosaic of habitats at the tract scale. Previously these values ranged from 80 BA up to 120 BA.

Due to the wide range of suitable habitat conditions and relatively small spatial areas of rare or sensitive plant sites, these sites will be addressed in individual THPs. Typically, rare or native plant sites are conserved following one of the following measures: (1) The site boundary shall be flagged as an Equipment Limitation Zone where operations shall occur following the blooming period or, (2) The site boundary shall be flagged as an Equipment Exclusion Zone or, (3) The site boundary shall be flagged and no operations shall occur within the boundary and a 50 foot Equipment Limitation Zone outside the boundary where operation shall occur following the blooming period. Due to the ability to work around these site boundaries and seasonal restrictions, there are no significant limits on productivity.

Historical or Currently Inactive Wildlife Site

These wildlife sites have been determined to be historical or inactive based on either lack of direct observations or a significant change in habitat has occurred since original use (e.g. nest tree has been blown down). Even if the site is determined to be historical or inactive, at no time shall the original den or nest site or any trees containing raptor nests be harvested.

II.C. Watercourse and Lake Protection Zones

Projections in this model have been constrained to estimate productivity losses for the protection of Class I and II watercourse and lake protection zones (WLPZ). This is primarily achieved by reducing the acres within GIS buffer zones along these WLPZs as specified in Section I.A.1. This is a straight acreage reduction to those affected stands and amounts to additional acreage outside of HCVF stands mentioned in the following Section II.D. This area reduction is an estimate for inventory and modeling purposes and is not intended for THP development or proposed THP measures. Specific WLPZ locations and protection measures will be detailed in individual THPs.

II.D. Limited or No Harvests within Forested Areas

Projections in this model have also been constrained for 52 High Conservation Value Forests (HCVF) stands with 1,870 acres of RRF ownership that will not be logged or will have limited individual tree removals. HCVF's are stands identified to meet requirements in the Forest Stewardship Council's (FSC®) Pacific Coast Standards. HCVF stands are defined by the FSC® standard as forests that contain environmental and social values of outstanding significance or critical importance at either a local or national level. Shasta Forests Timberlands LLC. has been annually third-party audited by Scientific Certification Services (SCS) to ensure that the RRF ownership is meeting the FSC® standards including identification and conservation of HCVF stands.

HCVFs are generally within and along some of the Class I watercourse zones, in seasonally wet areas, are economically infeasible to harvest, and/or are in areas that are incompatible with harvesting operations. In the model, these stands are included in the inventory and growth projection, but they are not harvested. Any limited harvesting that may occur in HCVF stands will not significantly change the projections. This harvesting is likely balanced to some degree by areas within regularly harvested stands that have small site-specific, no-harvest areas.

II.E. Non-Forest Areas

As described in Section I, there are 13,737 acres that have been typed as non-forest. These acres are not included in the model. They include rock or barren outcrops, wet meadows, lakes or large ponds, grassland, brush, hardwood or non-commercial conifer areas, and industrial areas. These non-forest areas are important habitat types to many mammals, birds, amphibians, fish, and native plants. Some of these areas may be included in individual THPs for skid or haul roads, operational areas, or for small areas of harvesting such as aspen, meadow, or wet area restoration. When these important habitat types are included within the boundary of individual THPs, site-specific measures are proposed in the THP to ensure that no potential significant adverse impacts occur to species using these habitats.

II.F. Large and Wildlife Trees

Large and wildlife trees are important habitat structural elements within forested stands. Large trees are retained within the RRF ownership through five primary methods: (1) FSC® certification legacy trees, (2) Large trees developed in WLPZ's (Section II.C), (3) HCVF's (Section II.D.), (4) Retention of non-merchantable trees greater than 16 inch DBH and less than 25% sound merchantable wood and, (5) Species-specific habitat types (Section II.B). The FSC® certification requires retention of legacy trees which are defined in the FSC® standard as a mature or old growth tree that provides a biological legacy. Legacy trees are painted, flagged and metal tagged for retention and entered into a GIS geodatabase. Large trees that are found within WLPZ's, HCVF's and species-specific habitat types may be painted with a "W" or identified using metal tree signs. In addition, wildlife trees that may display habitat structural elements important to wildlife, like but not limited to, existing or alternate nest structures, cavities, basal hollows, large horizontal branches, or mistletoe platforms are retained with a painted "W" or identified using a metal tree sign.

Criteria used for selecting large or wildlife trees is discussed during annual field training conducted by and with foresters and wildlife biologists. Both large trees and wildlife trees have been and are tracked in the inventory when they occur within inventory plots. These trees are not included in the data sets used in this analysis.

II.G. Snags and Large Woody Debris

Complex forest structures like snags, green culls and large woody debris (LWD) (e.g. fallen logs, stumps, root wads) serve a variety of important forest ecosystem functions. Functions include nutrient cycling, substrate for fungal, mycorrhiza populations, use as breeding and foraging habitat for many species of vertebrate wildlife, and habitat for many invertebrates, which serve as prey for wildlife species. Criteria or methods used for retaining complex forest structures are discussed during annual field training conducted by and with foresters and wildlife biologists. To continue to maintain and enhance snags and green cull trees on RRF ownership a series of guidelines are followed using site-specific information during THP preparation:

- (1) Tract level data collected within inventory plots is used to evaluate current snag and green culls. Snags and green culls will continue to be sampled in the on-going inventory cruises.
- (2) All green cull trees or snags that do not contain at least 25% sound wood volume and do not pose a safety risk or a potential hindrance to future access for initial attack of wildfire will be retained.
- (3) The tract level goal is to maintain 3.0 snags per acre on CWHR types with size class 3 and larger, and of these 0.5 snags per acre should be greater than or equal to 20-inch DBH, 0.25 snags per acre from greater than or equal to 24-inch DBH, and 0.1 snags per acre greater than or equal to 30-inch DBH.
- (4) For tracts falling below these goals, specific measures will include:
 - (a) A reduction in the intensity of sanitation/salvage operations and,
 - (b) Specific retention of appropriately sized trees that are likely to become snags within the next 10 years, with an emphasis on retaining and recruiting snags in the largest diameters and,
 - (c) Prohibition of falling snags under firewood permits.

To continue to maintain and enhance large woody debris on RRF ownership a series of guidelines are followed using site-specific information during THP preparation:

- (1) Tract level data collected within inventory plots is used to evaluate current LWD. Large woody debris will continue to be sampled in the on-going inventory cruises.
- (2) All LWD that do not contain at least 25% sound wood volume and do not pose a safety risk or a potential hindrance to future access for initial attack of wildfire will be retained.
- (3) Based on site-specific evaluation, LTO may be instructed to leave all LWD in place during all harvesting and site-preparation operations.
- (4) The tract level goal is to maintain 1 to 2 pieces of LWD per acre at least 10 inches in diameter and 10 feet long. This retention should focus within CWHR types with size class 3 and larger.

II.H. Hardwoods

Native hardwoods occur as a minor component of forested stands within many of the lower and middle elevations of the ownership. Since these hardwoods occur within forested stands, projections in this model have also been constrained by the retention of hardwoods within forested stands. Hardwoods consist of a few primary species including black oak, canyon live oak, big leaf maple, various willows, quaking aspen, alder, and cottonwood. Mature hardwoods provide valuable wildlife habitat elements for many species of wildlife. These hardwoods provide structures, broken top trees, cavities and basal hollows that serve as breeding and denning site. Also, hardwoods provide important forage for wildlife in the form of mast or acorns.

Currently, there is a limited amount of hardwood removal by commercial and non-commercial firewood cutters. Other than firewood there have been no markets for hardwoods for the past 25 years, and none are anticipated in the future. Due to the importance of hardwoods diameter, height, and crown data on all hardwoods is collected during the on-going cruises and is maintained in the inventory. The growth of hardwood trees is projected along with conifers in both the FORSEE and CONIFERS growth models. However, there is no volume assigned to hardwoods. In the timber assessment model harvesting of hardwood occurs at a lower intensity than conifers, as detailed in Section I.B.4. The relative composition of hardwoods to conifers does not significantly change during the planning horizon,

as evidenced by predicted CWHR types. To continue to maintain and enhance hardwoods on RRF ownership a series of guidelines are followed using site-specific information during THP preparation:

- (1) Landscape level data collected within inventory plots is used to evaluate current hardwoods. Hardwoods will continue to be sampled in the on-going inventory cruises.
- (2) Hardwoods are generally not harvested during uneven-aged harvests. In forested stands with significant amounts of hardwoods, the RPF and wildlife biologist will review the hardwood distribution and density and propose a more aggressive site-specific treatment of hardwoods in the THP, if necessary. As an example, if hardwoods occur in densities high enough to preclude forest conifer management, a representative sample (usually around 10-20% of the original hardwoods) are individually marked for retention and would be proposed in the THP.
- (3) In THPs that are harvested using even-aged methods, mature oaks are specifically retained for wildlife habitat. These oaks will be retained as part of variable retention methods (Section I.B.4.a.1).
- (4) Hardwoods specifically retained within both uneven-aged and even-aged harvests will also be retained during post-harvest site preparation and vegetation control management activities.

II.I. Regional Economic Vitality

As demonstrated in this assessment, timber yields are consistent and sustainable. The supply of timber resources provides the raw materials for sustaining the health of the local and regional economies that are dependent on the timber industry. These raw materials provide for employment in the logging, trucking, milling, retail sales, and other associated industries that provide the commercial infrastructure and economic stability for the local and regional communities. Economic vitality in these rural communities also provides incentives for investment from other sources. In addition, federal, state and local tax receipts generated from income tax revenues, payroll taxes, State Board of Equalization timber yield taxes, property taxes, and retail sales taxes are enhanced.

WBA employs approximately 30 permanent and seasonal employees. In the performance of their management duties, equipment, supplies, vehicles, and services are purchased locally. WBA supports local communities through annual financial contributions to many organizations and associations. Many employees are involved and dedicate both time and finances to professional and community-related projects and organizations.

II.J. Other Forest Values

The protection of other forest values such as range, forage, aesthetics, recreational enjoyment, and archaeological resources is an important objective of RRF. These values have existed along with selection harvesting on RRF for many years. There are no limits to productivity beyond the existing constraints in the model.

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Appendix A. 2020 Growth Study Results

Table A1 is a list of permanent growth plot clusters that were used to assess tree growth. The plot clusters are also shown on the map Figure A1. The table shows the cluster name, tract, site quality, number of trees measured, the year of the previous measurement, the year of the re-measurement, and the total growth years.

For each tree in the growth plot database that was alive at both the original measurement and the re-measurement, several attributes are tracked, and a comparison is made for diameter and height between actual growth and modeled growth in FORSEE. A calculated ratio of means is used as a way of estimating calibration factors. This process is considered non-biased for growth model calibration (Dr. Bruce Krumland, personal communication and private write-up with statistical results and graphs. The write-up is available upon request.). The ratio of means is calculated as: $\text{sum (GD2)}/\text{sum (GFD2)}$ for diameter and $\text{sum (GH)}/\text{sum (GFH)}$ for height, where:

- GD2 = Annualized difference between the actual (measured) squared diameter and the initial squared diameter.
- GFD2 = Annualized difference between the modeled (FORSEE) squared diameter and the initial squared diameter.
- GH = Annualized difference between the actual total height and the initial total height.
- GFH = Annualized difference between the modeled total height and the initial total height.

The ratio of means is observed across tracts, species, and site quality, as shown in tables A2 through A4. Not enough data was available to make comparisons beyond tract or species or site quality. Many of the calculated values show poor growth results. However, there are several reasons for ‘tempering’ these results, including:

- Relatively small sample size. The total number of growth plot trees is less than 1% of the trees in the inventory database. Some forest types are not sampled at all.
- These results are lower than several previous calibration and growth analyses.
- The drought conditions in the years 2012 through 2015, and in many of the last two decades is in these results compared to different conditions for CACTOS data. Drought is expected in future years (AghaKouchak 2014, Diffenbaugh 2015), but the magnitude and duration are not yet clearly known, and some have suggested improved growth with increased carbon in the air, longer growing season, and rainfall.
- The future use of group openings is expected to increase to meet regeneration goals, and growth within and on the edge of group openings is increased (Blodgett studies).

As a result of this study, the calibration factors were lowered to 90% of actual diameter growth and 90% of actual height growth for all stands in all growth runs. In addition, stand site index was lowered for all areas for SP and DF, and site index was reduced by a value of 3 for low site areas including the Cheney

Creek Tract, the Harvey Tract, and northeast portion (units 29 through 32) of the Jimmerson Tract (39% of the tract).

Table A1. List of plot clusters used in this growth study.

Cluster	Tract	Site	Trees	From	To	Years
1011076	Shasta	High	27	2004	2019	15
1011079	Shasta	Med/low	14	2004	2019	15
1021149	Shasta	Med/low	25	2004	2019	15
1021297	Shasta	Med/low	89	2004	2019	15
1111058	Pondosa	Med/low	100	2001	2015	14
1111212	Pondosa	Med/low	29	2004	2019	15
1111299	Pondosa	Med/high	12	2004	2019	15
1121028	Pondosa	High	11	2004	2019	15
1311006	Jimmerson	Med/low	11	2004	2019	15
1311027	Jimmerson	Med/low	21	2004	2019	15
1311183	Jimmerson	Low	28	1998	2015	17
1651047	Susanville	Low	82	1999	2015	16
1711016	Brush Hill	Med/low	44	2009	2019	10
1711106	Brush Hill	Med/high	41	2009	2019	10
1911133	Cheney Creek	Low	58	2010	2019	9
1911210	Cheney Creek	Low	73	2011	2019	8
2011006	Moonlight	Med/low	149	2011	2019	8

Table A2. Calculated ratio of means (Brm) for diameter and height by Tract.

Tract	Trees	DBH Cal	Ht Cal
Brush Hill	85	0.99	0.66
Cheney Creek	275	0.62	0.76
Jimmerson	58	0.71	0.76
Moonlight	149	0.92	0.88
Pondosa	147	0.88	0.85
Shasta	151	1.02	0.79

Table A3. Calculated ratio of means (Brm) for diameter and height by species.

Species	Trees	DBH Cal	Ht Cal
DF	113	0.80	0.65
IC	87	0.82	0.90
JP	124	0.73	0.70
PP	340	0.82	0.88
SP	42	0.90	0.71
WF	159	1.03	0.74

Table A4. Calculated ratio of means (Brm) for diameter and height by site class.

Site Class	Trees	DBH Cal	Ht Cal
High	38	1.23	1.07
Med/high	52	0.93	0.61
Med/low	473	0.93	0.79
Low	302	0.63	0.77

Mortality was also tracked. As expected, and largely driven by the drought years, actual mortality tracked in the growth plots (approximately 7.5% of trees) outpaced FORSEE modeled mortality (5.5% of trees). The sample size for mortality is small and variable. There was no recognizable pattern of difference among species, tracts, or tree size.

Plantation growth was also studied. This was a much easier task as each plantation age was known, and sampling has occurred on all plantations after the age of 15. These results can be seen by looking at the statistical attributes (BA, volume, etc) versus the stand age. However, great variation is observed in situations where residual trees were left from the previous stand, or in situations where brush and/or natural seeding of hardwood and conifer trees has occurred.

Plantations grow much faster than natural stands in general. FORSEE's underestimated growth of plantations is well known. With the increased site index of these stands (section II.A.6) these underestimates are less significant.

Figure A1. Map showing growth plot cluster locations.

