This is a reduced version of the Metolius Preserve Forest Stewardship Plan. figures, tables, and more than 100 pages of text have been removed. There is a glossary at the end of the document that defines specialized terms.

EXECUTIVE SUMMARY

The Metolius Preserve is a 1,249 acre forested ownership in the Metolius River Watershed near Camp Sherman, Oregon. The preserve is comprised of three parcels including Sections 17, and parts of Sections 19 and 29, within Township 13S Range 6E. The property supports abundant wildlife including mule and black-tailed deer, black bear, cougar, bobcat, badger, beaver, and a host of forest-dependent bird species. It also provides critical winter range for a herd of Roosevelt Elk. Several forks of Lake Creek flow across the property, all small fish bearing streams. These tributaries connect Suttle Lake with the Metolius River.

The Land Trust's acquisition of this property is a key part of the *Back to Home Waters* campaign. This ambitious program involves numerous local and regional partners in preserving and restoring the most critical Deschutes Basin habitats for the reintroduction of anadromous fish to their home waters. One important component of this program centers on re-establishing sockeye salmon and steelhead to Suttle Lake, now cut off from historic headwater runs by Round Butte and Pelton dams, and other fish barriers. Purchase of this ownership secures a key private forest in a landscape of protected lands that contain these headwater runs. This acquisition, along with planned restoration of forest and streams within the preserve will contribute toward re-establishing sockeye salmon and steelhead to Suttle Lake. Stewardship efforts on the preserve will also contribute to the broader vision of restoring ecosystem processes and functions to the forests of the Metolius Basin. The recent B & B fire complex demonstrated the risk lower elevation pine forests face due to years of fire suppression and timber harvest. This area represents one of the best opportunities to restore mature ponderosa pine at a landscape-level in the Pacific Northwest. Benefits of these efforts will be far reaching, the most significant being reversing declines of wildlife species associated with this forest type, and reducing catastrophic fire risk to forests and private properties in the Basin.
The Metolius Preserve Forest Stewardship Plan: A Framework for Restoration provides the preliminary analysis, design, and management schedule for achieving this vision. The document includes an assessment of current forest resource conditions, descriptions of desired future conditions, an analysis of management pathways and recommended prescriptions, an implementation agenda, and monitoring plan.

The Metolius Preserve is composed predominantly of evenage ponderosa pine stands (Ponderosa Pine Cover Type) ranging in age from regeneration to 120+ years old. Other overstory cover types include the Mixed Conifer Type (32% of ownership by acres), Western Larch Type (2%), and Douglas-fir Type (1%). Decades of intensive forest management have created diverse age class and structural conditions across the ownership[1][1].

By traditional forestry standards the preserve is well-stocked with trees, and moderately resistant to high severity fire. However, analysis based on future management objectives indicates the need for restorative treatments across most of the ownership. Using reference

[1][1] We delineated 30 stands on 18 forest types based on dominant species cover, tree size, and stand development stage.

conditions for comparison, we determined the ownership departs from desired conditions on the majority of acres in 8 of 9 key stand parameters[1][2]. Changes in stand structure and composition compared with reference conditions have resulted in a loss of key habitat features, including snags, large diameter pine, and open understories, that are needed by focal wildlife management species such as the white-headed woodpecker. For example, current snag levels across the ownership are depauperate in large diameter low to moderately decayed ponderosa pine snags. Recruitment of adequately sized pine snags is hindered by lack large trees diameter. The current distribution of age classes on the preserves has been highly altered from reference conditions. Historically, stands on the preserve developed unevenaged structure, composed of distinct groups of evenage trees, as a result of high frequency-low to moderate intensity disturbance regimes. Currently, patches of evenage forest are much larger and with a narrower range of ages. This departure from reference era age class structure has serious implications for long-term sustainability of the forest.

Our analysis of fuel levels and potential fire behavior and effects suggest active management is needed to achieve future objectives. Fire behavioral modeling predicted crown fire potential on 693 of 1,249 acres during extreme fire weather. This simulated result is due to a number of factors including high overstory tree density, surface and ladder fuels in some stands. Fire suppression has increased understory tree stocking levels of grand fir across the ownership. At least five stands, totaling 576 acres have patchy to dense understory tree layers (ladder fuels) that could contribute to high intensity fire conditions even during average summer weather. We predict similar conditions will occur within 20-50 years over much of the ownership if these stands are unmanaged. Fire hazard on the preserve is compounded by adjacent highly overstocked USFS lands. Some of these areas will be treated as part of the Metolius Basin Forest Management Project. However, some adjacent areas will be maintained at tree densities that pose elevated fire risk to the preserve to meet habitat needs of species associated with moist, multi-stratum mixed conifer forests. While current overstory tree stocking is below bark beetle thresholds on most of the preserve, there are 573 unthinned acres that will exceed these levels in the next 20 years. Surface fuels mostly from slash from recent timber harvests are considered well beyond reference conditions across most of the preserve, and present visual concerns as well as increased fire potential.

Future desired conditions (DFC), which serve as targets upon which management prescriptions will be based, were assembled for each stand on the Metolius Preserve. Three general sets of DFC were developed for the preserve based on Plant Association Group and reference conditions. DFC were modified to achieve specific objectives such as increasing shade along Lake Creek, or maintaining wildlife connectivity corridors in coordination with USFS management plans. In general, DFC for the preserve include open stand structure dominated by large diameter ponderosa pine. Western larch and Douglas-fir are co-dominant with pine on more productive sites. Stands are arranged in an unevenaged distribution of tree structure in approximately.13-1 acre age class groups, spaced 25-50 years apart. The desired large tree visual effect will be maintained by not exceeding 20% of stand area in groups < 75 years old. Tree spacing patterns should mimic those created under reference era disturbance processes. Stands should contain 3-4 snags per acre >20" dbh, both clumped and scattered, in a variety of decay classes. Species composition for snags should be proportional to overstory tree dominance.

[1][2] Reference Conditions classify stands based on their presumed structure and composition prior to Euro-settlement. Reference conditions provide a baseline to assess the degree of departure from historic conditions, and a framework to determine a range of desired future conditions.

Understory vegetation should be native grass and forb dominated (species appropriate to plant association type) with <15% shrub cover. Understory will also contain widely scattered tree regeneration groups. Riparian DFC allow higher tree stocking, some multi-stratum tree structure, higher snag, down wood levels and shrub cover.

DFC can be achieved using a variety of management pathways, each with tradeoffs. The strategy recommended in this plan includes use of thinning, prescribed burning, mowing, and other silvicultural treatments. Stand thinnings focus on accelerating diameter growth in younger pine stands by removing trees competing with largest and healthiest trees, reducing ladder fuels, and encouraging a variable residual tree pattern while maintaining pine and western larch dominance. Thinning to low stand densities in some areas is advocated as a way to substantially reduce time to produce large tree structure and high quality snags used by focal management species. These treatments will prepare stands for return of a prescribed burning regime on a 10-20 year interval. Use of both fire and mowing is scheduled to reduce shrub cover, duff and litter buildup, slash, and grand fir regeneration. Other treatments include protecting and releasing pine and larch regeneration in heavily harvested areas, rehabilitating unneeded log landings, skid trails and roads, controlling noxious weeds, and re-establishing native grass cover in old burn pile areas. Treatments are prioritized based on areas at highest risk of high severity fire, necessary order of operations in forest restoration (thinning precedes prescribed burning) and coordination for joint land trust/USFS treatments.

The framework for forest monitoring is established in the final section of this plan. This system is based on two scales: Treatment Effectiveness Monitoring, and Long Term Management Monitoring, using a combination of cursory walk-through exams, periodically remeasured permanent stand inventory plots, and repeat photography.

INTRODUCTION

Metolius Preserve Overview

The Metolius Preserve comprises 1,249 acres of predominantly young ponderosa pine and mixed conifer forest, situated in Central Oregon on the eastern flank of the Cascade Mountains, in southwestern Jefferson County (see Map 1). Topography on this entirely forested ownership is flat to very gently sloped. The preserve occupies a narrow elevation gradient between 3,000-3,100 feet. The ownership is contained within the Metolius Basin, a 240,000 acre watershed. Several perennial branches of Lake Creek run through the preserve. These perennial streams feed the Metolius River, a major tributary of the Deschutes River.

Forest Use History

The first peoples to occupy the Metolius Preserve and surrounding landscape included the Wasco, Warm Springs and Paiute tribes. These lands were likely used as hunting and ethno-botanical collection grounds. The precise extent of manipulation by the Native Americans is unknown. However, it is generally accepted that native burning is partially responsible for the structure and composition of "reference condition" forests throughout the dry forest types of the intermountain west.

In the post Euro-settlement period, the preserve has been owned and managed as a timber resource for at least the last 80 years. Brooks-Scanlon, Inc. owned the property from about 1920 to 1978, when Diamond International Corporation bought Brooks-Scanlon. In 1980, Sir James Goldsmith of Cavenham Forest Industries purchased Diamond and managed the property until 1988, when Crown Pacific purchased the property. Soon thereafter, Crown sold the property to Willamette Industries, who managed the property from 1988 to 2002. In the spring of 2002, Weyerhaeuser acquired Willamette Industries.

In late July 2003, the ownership was purchased by, the Deschutes Basin Land Trust.

Resource Assessment

Physical Environment

Climate

Climate on the Metolius Preserve is strongly influenced by maritime and continental weather patterns. In the winter, low-pressure systems originating in the Pacific Ocean bring abundant moisture in the westerlies. The Cascade Mountains, directly to the west, form a major barrier to eastward movement of this heavy winter precipitation. Annual precipitation averages approximately 30 inches in the vicinity of the Preserve. The preserve receives most of its moisture during winter months, in the form of snow and rain. Average January precipitation in the area is 4.5 inches, while average July precipitation is 0.6 inches. Temperatures range from a mean of 68 degrees F in July, to 32 degrees F in January.

Forest Resources

The Metolius Preserve is a forested landscape, comprised of managed stands dominated by ponderosa pine (*Pinus ponderosa*), grand fir[1] (*Abies grandis*), Douglas-fir (*Pseudotsuga menzesii*) and western larch (*Larix occidentalis*). The 1,249 acre ownership is 99% forested, with the remainder in roads, landings, and streams. Over the last century the ownership has been intensively managed for timber production. Consequently, the current distribution of forest structure and composition is heavily influenced by timber harvests in addition to site factors (soils, elevation, topography, climate). Variations in these site factors and in the silvicultural practices, which have been applied over the last century, have resulted in a landscape that is quite diverse in age class distribution, tree species and understory vegetation composition, stocking levels, and canopy structure.

Current Disturbance Regimes

Timber Harvests

The Metolius Preserve is a heavily managed landscape; multiple-timber harvests have occurred throughout the entire ownership over the last century. Three significant periods of logging are evident from stump and tree ages: the early 1900s, 1930s-40s and within the last decade. Harvests since 1993 include regeneration cuts (small clearcuts, shelterwood and seed tree) and commercial thinnings. Timber harvests constitute the greatest disturbance, having supplanted fire. These harvests have supplanted fire in constituting the most impacting disturbance across the landscape since the reference period.

Insects and Disease

Forest insects and disease play pivotal roles in western forest ecosystems; they support nutrient cycling, soil productivity, food chains, and influence structure/composition at fine and broad scales. In this assessment, we discuss mainly those species likely to have the greatest impact on the preserve. We did not find any evidence of major insect/disease problems on the preserve. We base this finding not on the absence of these agents, but on their patterns and extent of mortality within a "normal" range, defined by reference disturbance regimes. The most significant departure in insect/disease processes on the preserve are root rot pockets (described below).

Bark beetles are the most important insect agent in terms of tree mortality and effect on tree vigor, species composition, snag and surface fuel levels. Evidence of fir engraver (*Scolytus ventralis*) attack on grand fir trees is common, especially in areas along the North Fork Lake Creek and Stand 1707. Bark beetles typically respond to drought stress, root rot, insect defoliators, and/or heavy fresh slash/windthrow (see below).

Western pine beetle (*Dendroctonus brevicomis*) is the prominent *Dendroctonus* species in ponderosa pine. We found evidence of both species on the preserve. These species occur at background levels, occasionally killing individual trees. This species can erupt in drought

[1] Grand fir on the preserve have crossed with white fir (*Abies concolor*). We refer to this cross as "grand fir" in this document.

stricken or fire damaged stands. We noted one ponderosa pine snag with extensive beetle galleries. Other bark beetles, likely present on the preserve, include Douglas-fir bark beetle (*Dendroctonus pseudotsugae)* on Douglas-fir, and Pine engraver (*Ips pini*) and Red turpentine beetle (*Dendroctonus valens)* on ponderosa pine.

Current vs. Reference Stand Conditions and Disturbance Regimes

The Metolius Preserve is positioned on the western edge of an expansive ponderosa pine forest ecosystem that cloaks the lower eastside slopes of the Cascade Mountains. This forest belt still exists, but has been dramatically altered in structure, composition, and function over the last 150 years. Much of the pre-settlement forest was a continuum of what many today would call "old growth" pine forest. Stands often appeared evenaged, but actually were composed of multiple cohorts of trees arranged in groups across the landscape at scales of .05- 1 acre (Agee 2002). Unevenage stands often appeared as a single stratum of large diameter pine. This was due to the grouping of distinct age classes and different growth rates of large vs. younger trees (i.e. younger trees grow at a faster rate than old trees, giving the appearance that all of the trees are the same age).

These open pine stands typically had sparse understories, dominated by bunchgrasses and scattered shrubs, with composition and percent cover varying with site productivity and herbivory levels.

The shaping and maintenance of the stand structure described above resulted from a reference disturbance regime with high frequency/low severity fires as its centerpiece. These ground fires typically burned during the summer and fall; consuming litter, tree regeneration, and other surface fuels. Fire on the Metolius Preserve was a crucial factor in maintaining open understories because these sites are so productive. Without this understory "cleaning," more shade tolerant species would regenerate and eventually create dense, layered forest conditions susceptible to damaging insects and stand replacing fires. We suspect fire patterns on the ownership varied within the bounds of the high frequency/low severity regime due to the mosaic of well-drained mesic and moister "fire insulated" conditions. On the well-drained upland soils, fires were probably very frequent and predictable in their intervals. On wetter sites, particularly in the glacial outwash plain and adjacent to riparian areas of Lake Creek, fire intervals were still frequent, but probably included fire free periods sufficient for tree species intolerant of fire at early ages (e.g. Douglas-fir, grand fir, incense cedar) to regenerate. Along with fire, bark beetles played a key role in shaping forest structure and the unevenage age class distribution. Western pine beetles would create small openings in the forest by killing one or several mature pines (see Figure 1). Tree regeneration would develop in these openings (pine would be favored because it can withstand fire at a very young age). Over time, these groups of evenage pine form/maintain a forest that is unevenage in structure. Some evidence suggests disturbance events (e.g. pine butterfly, fires during extreme droughty periods) caused group mortality at larger scales. However, these events were probably very infrequent. Overwhelming evidence from early Euro-settler accounts and photographs support the reference condition as an open forest structure.

The conditions described above fit our general impressions of stand structure/composition on the Metolius Preserve. Our assessment of reference stands on the ownership is guided by: stump records, General Land Office surveys between 1851-1909, and adjacent, relatively undisturbed USFS stands on similar soils. Collectively, these sources convey a landscape dominated by well-

spaced ponderosa pine (see Photo 9), although many current stumps on the property are from large diameter Douglas-fir trees. These trees were almost all established after the turn of the century and released following logging.

In contrast, the large, scattered and highly decayed pine stumps are typically 200+ years of age. We located two very large Douglas-fir stumps and several reference era trees that indicate this species occurred on the preserve. These stumps occur within the moistest, most productive sites in the outwash plain. The picture that emerges is a reference condition of pine dominated stands across the preserve, with scattered Douglas-fir and western larch on the outwash plain and more well-drained areas north of the North Fork Lake Creek. Map 5 demonstrates this estimation of reference stand conditions. Grand fir was probably uncommon, except within inner riparian zone. Tree spacing, based on stumps, ranged from 25-40', with stocking levels increasing with site productivity. We suspect reference tree stocking levels were in the 90th percentile among ponderosa pine stands in the region, due to the very high productivity of the sites.

Vegetation changes that have occurred on the preserve since the reference period are indicative of those affecting the greater eastside pine ecosystem. In general, they include: A) A transition from pine to fir dominated overstories on moist sites. B) A change from both single and multi-stratum unevenage stands with big tree structure, to younger even- age stands, often lacking large tree structure. C) A decrease in stand size (i.e. increased stand mosaic). D) Increased homogeny within stands. E) An increase in the proportion of shrubs to grass and open areas. F) An increase in surface fuels, particularly 1-100, and smaller 1000 hour fuels. G) A decrease in large pine snags.

Fuels Assessment

Surface fuels on the preserve differ from reference conditions in the following ways:

- We estimate total fuel loads are currently more than 7 times the hypothesized reference stand estimates[1].

- Fine fuel levels (< 3" diameter) in stands that have been harvested during last decade greatly exceed reference estimates.

- Fuel levels (3-20" diameter) in stands that have been harvested during last decade greatly exceed reference estimates. We estimate current fuel loads (<20" dbh) exceed reference estimates.

- Fuel levels (20"+ diameter) are likely consistent with reference conditions in some stands. Four stands (1703, 1707, 1715, 1717) had loads exceeding reference levels.

- Fine fuels are more evenly distributed than reference stands which tended to have widely scattered fuel "jackpots" where bark beetle killed trees fell.

[1] Reference surface fuel level was calculated using Agee's (2002) estimate + .84 tons per acre for <20" fuels not accounted for by Agee.

- Average fuel bed depth is estimated to be higher than reference condition. In heavily managed stands the fuel bed depth is represented by, 1-1000 hour fuels (slash and logs of all sizes). In contrast, this fuel bed depth is largely litter (unfermented pine needles) throughout Parcels 19 and 29.

Snag and Down Wood Resources

Dead wood in the form of snags, down woody debris, stumps, root wads, and heart rot infected portions of live trees serve many useful ecological functions in Pacific Northwest forests. While these structures are widely recognized for their role in providing habitat to many wildlife and invertebrate species, dead wood also contributes to soil building processes, erosion control, nutrient cycling and refugia of both fungi and small mammals during fire events. Dead wood is particularly important to a number of wildlife species that use these structures for lookout sites, reproduction, hibernation, feeding, resting, sunning, drumming, preening, and dusting. The specific function of dead wood varies widely with the forest type and inhabiting species. In the frequent fire regimes associated with ponderosa pine types, snags likely represented a larger proportion of dead wood because down wood was quickly consumed in surface fires. The importance of snags to many species in ponderosa pine forests is well documented.

Current Snag Conditions

The combined snag density for the ownership was 2 snags/acre (See Figure 3 and Appendix J). The average snag size was 12.9" dbh, and 33' in height. Parcel 17 had the highest snag density (5.2 snags/acre) followed by Parcel 19 (4 snags/acre). Parcel 29 had the lowest snag density (.26 snags/acre). The highest concentration of snags was found along the north side of the North Fork Lake Creek in Stand 1707. Most of these snags are grand fir and Douglas-fir killed by root rot and bark beetles. The lowest density of snags occurs in 50-70 year old ponderosa pine stands. For example, Parcel 29, which is entirely composed of young pine, had only .26 snags per acre. When all stands of 50-70 year old pine were combined, density averaged 2.19 snags/acre.

Snag Conditions in Relation to Management Objectives

A key management objective on the Metolius Preserve is to restore stand structure and composition to provide habitat for species associated with mature ponderosa pine forests. To assess whether snags currently provide suitable habitat for these species, we examined both the probable levels of snags in historic pine dominated forests and research quantifying snag density, distribution, species, size, and decay stages for cavity nesting animals in these forest types.

Snags Levels in Reference Conditions

Several recent research papers have examined snag conditions in pine dominated forests prior in pre-white settlement period. Harrod et al. (1998) estimated historic snags densities in ponderosa pine dominated, dry forests. They estimated that densities of snags > 6" dbh ranged from 5.9-14.1/acre in pre-European settlement landscapes. Reference snag densities was 1-2 snags/acre >19" dbh. They derived their estimates by calculating growth in basal area from pre-1930 growth rates, holding forest stand structure relatively constant (i.e. as a new live is recruited another one dies), and applying published snag fall rates to calculate basal area of snags every 10

years. Agee (2000) estimated lower snag densities than Harrod et al. (1998) for the Ponderosa Pine/Douglas-fir forest series by estimating number of trees in 0.1ha clumps of 16 age classes and assuming that the oldest patch is killed by insects every 25 years. His estimated historic snag density (average size of 30" dbh) was 2/acre. Korol et al. (2002 and unpublished data) derived historic range of variability (HRV) for snag densities in dry forests with a low-intensity fire regime of 0.4 to 0.7/acre > 20 in). HRV was determined by subtracting and adding 30% to the average of 1.5 snags/ha > 51 cm dbh (0.6/acre > 20 in). They derived their estimates through review of the literature and discussion with experts.

Current snag resources on the Metolius Preserve are probably outside the range of historic conditions occurring on this site, in terms of snag density, distribution, species, size, and decay class. For example, 30% of the snags on the preserve are grand fir. We suspect there were many fewer grand fir snags on the preserve. While 59% of all snags are ponderosa pine, this percentage was likely above 90% in the reference condition forest. Overall, snag density is probably within a reasonable range from reference condition, but for ponderosa pine these snags are highly skewed toward small diameter trees (79% of pine snags are 8-10" dbh) and highly decayed class in the larger size classes. There were only .07snags/acre in the 30" and greater size class. Of these few snags, 94 % were highly decayed.

Management Targets

Given our management objective of managing for both a target tree structure/composition and associated wildlife species assemblage similar to mature historic open dry/moist ponderosa pine stands, we feel the target snag density should reflect those levels estimated under historic conditions. Although the three studies that examined historic snag levels can not be directly compared because they report snag levels in different dbh classes, we have roughly approximated 2 snags/acre >25" dbh as reasonable interpretations of their data. This diameter exceeds or approximates the mean diameter of snags chosen by most species that utilize this resource in ponderosa pine dominated forests. The two studies that examined snag requirements of white-headed woodpeckers (a focal management species) report a mean of approximately 2 snags/acre (Dixon, 1995, Frenzel, unpubl. Data). Marcot et al. (2002) list 4 snags/acre >20" dbh for managing white-headed woodpeckers at the 80% Tolerance Level[1].

Decay Classes

Snag preference among wildlife is partially determined by decay stage. For example, in the ponderosa pine type species such as northern flicker *(Colaptes auratus)*, American kestrel *(Falco sparverius)*, violet-green swallow *(Tachycineta thalassina)*, and some bat species chose highly decayed soft snags. White-headed woodpeckers prefer moderately decayed soft snags. Most species in this habitat guild prefer moderately decayed snags.

Tree Species

In dry and moist ponderosa pine types, many cavity nesting species prefer or require ponderosa pine and western larch snags for nest sites. Ponderosa pine is the most widely used species due, in large part, to the high proportion of sapwood in this species. Sapwood decays faster in dead

[1] White-headed woodpecker (WHWO) data are from a population where adult mortality is outpacing recruitment

trees. The thick layer of sapwood provides a deep layer of material for excavation. All of the focal management species on the Metolius Preserve use ponderosa pine snags as a primary choice. This species is particularly important as a nest site for white-headed woodpecker and flammulated owl. However, other tree species fill ecological niches due their varied decay rates, tree size, architecture and anatomy. For example, Douglas fir is utilized widely as a forage snag. Bark sloughing provides nest sites for bats and species such as brown creeper. Grand fir tends to develop extensive heart due to Indian paint fungus, which provides large hollow cavities used by colonizing species such as bats and Vaux's swift *(Chaetura vauxi)*, den sites for black bear *(Ursus americanus)*, and rest/roost sites for pileated woodpecker. Western larch snags provide nest sites for several species that also prefer ponderosa pine, including black-backed woodpecker *(Picoides arcticus)*, pileated woodpecker and Williamson's sapsucker *(Sphyrapicus thyroideus)*.

Invasive Weeds

The invasion of non-native plants has emerged as one of largest threats to maintaining biological diversity throughout the west. Noxious weeds are a group of non-native plants that have been designated, "noxious," by law due to their negative economic and environmental impacts, and ability to rapidly spread. The biology of non-native plants often allows them to out compete natives; many have no natural biological controls because they have not evolved in these plant communities. They also have adaptations that often allow them to out compete natives in disturbed environments. Many of these non-natives threaten biological diversity because they are able to replace a diverse understory assemblage with a single species.

The State of Oregon maintains an invasive weed list; species are assigned to one of the following three classes:

Class A Weeds: Non-native plants of known economic importance which occur in the state in small enough infestations to make eradication possible; or is not known to occur, but its presence in neighboring states make future occurrence in Oregon imminent.

Class B Weeds: Non-native plants of economic importance which is regionally abundant, but which may have limited distribution in some counties.

Class T Weeds: Non-native plants that are priority weeds designated by the State Weed Board as a target weed species on which the Department will implement a state wide management plan.

Table 5. *Noxious weeds on the Metolius Preserve and Status*

Common Name:	Scientific Name:	Noxious Weed Class:
Bull thistle	*Cirsium arvense*	B
Spotted knapweed	*Centaurea maculosa*	B,T
Scotch broom	*Cytisus scoparius*	C
Houndstongue	Cynoglossum officinale	B
Tansy Ragwort	*Senecio jacobaea*	C

Rare and Listed Plant Species

Table 6. *Known or probable rare and/or listed plant species occurring on Metolius Preserve*

Common Name	Scientific Name	Probability of Occurrence	Status
Peck's penstemon	*Penstemon peckii*	Documented	G3,S3, Fed SOC
Tall agoseris	*Agoseris elata*	Possible	G4,S1
Water lobelia	*Lobelia dortmanna*	Documented*	G4,G5, S1,

G3 Vulnerable—Vulnerable globally, either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.
G4 Apparently Secure—Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.
G5 Secure—Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
S1 Critically Imperiled—Critically imperiled in Oregon due to extreme rarity or because of some factor(s) making it especially vulnerable to extirpation. Often 5 or fewer occurrences or very few remaining individuals (<1,000).

Fish and Wildlife

Fish Species, Habitat and Conditions

Fish and wildlife managers have identified Lake Creek as important habitat for native redband trout, bull trout, and salmon. Salmon passage is currently blocked by Round Butte and Pelton dams. Game fish known to occur in Lake Creek include redband trout, brown trout, brook trout, kokanee salmon, bull trout and whitefish, while non-game fish that use Lake Creek include longnose dace and sculpins (Dachtler, 2003). ODFW intends to conduct regular redd surveys of Lake Creek through the property. Bull trout use lower Lake Creek, but have not been found as far upstream as the Preserve (Wise, 2003). For a thorough discussion of current and historic fisheries in Lake Creek, refer to Dachtler, 2003.

Lake Creek was historically an important Chinook spawning area (Nehlsen, 1995). In preparation for the reintroduction of salmon into the Metolius basin, biologists have released spring Chinook fry into the Metolius River and its tributaries to determine seasonal distribution and habitat use of juvenile Chinook salmon. Preliminary results show that the highest densities and the greatest total number of juvenile Chinook salmon were found in summer and fall (2002) in upper Lake Creek (south fork) (Lovtang and Li, 2003). Chinook spawn in the fall, emerge in the spring, and migrate the following spring (Riehle, 2003).

Sockeye salmon historically used Lake Creek to reach Link Creek, the native spawning grounds for sockeye rearing in Suttle Lake (Nehlsen, 1995). This was one of Oregon's two historic sockeye salmon runs (the other run was associated with Wallowa Lake in northeastern Oregon).

Historic records of upstream migrating sockeye at the Pelton dam from 1956-1961 indicated the run passed between June and October, peaking in August. Spawning occurred in the fall, from mid-September to November. Juveniles spent one to two years rearing in fresh water, eating plankton, before migrating downstream between March and July, with the peak out-migration time in April (Nehlsen, 1995).

Chinook salmon will likely use Lake Creek for spawning and rearing. Larval and adult insects are the primary food source for rearing Chinook (Groot, 1998). A healthy riparian community within and along the creek helps support this food chain, as well as provide for cover to fry during high flow events. However, Chinook don't tend to spawn in small streams where the flow is too low, as may be the case with the South Fork through the Preserve. Instead, they may favor Lake Creek below the point that the Middle and South Forks join for spawning (Riehle, 2003). Since Chinook have been observed to spawn in a wide range of velocities and depths throughout their range, it is difficult to establish meaningful minimum and maximum criteria for these factors While it is conventional wisdom that Chinook prefer faster, deeper rivers for spawning, results of studies indicate that in some cases Chinook have spawned in shallow water and low flows (Groot, 1998). Juveniles may disperse along Lake Creek upstream to the Preserve (Riehle, 2003). Favorable habitat conditions include a high pool: riffle sequence. Chinook prefer deep pools for rearing, and spawn in the pool tail crest where there is good flow through of gravels (Riehle, 2003). Average maximum pool depth along the South Fork (2.4 feet) is deeper than that found in the either the Middle or North Forks (Dachtler, 2003).

Sockeye will likely use Lake Creek through the Preserve (Middle and South Forks) during the summer-fall adult upstream migration and the juvenile spring-summer out-migration. Plentiful pools and good bank structure allow for holding, resting, and cover. Good cover of forest and riparian shrub species provides shade to maintain water temperatures and food in the form of leaf detritus. No passage barriers will help ensure the successful migration of sockeye. There are no known passage barriers on the South and Middle Forks of Lake Creek through the property. On the South Fork, a couple of log and debris dams help enhance habitat diversity by providing good cover, trapping deciduous leaf litter- which enhances the macroinvertibrate population, and also by causing pools to form above the jams (Riehle, 2003).

Wildlife Species, Habitat and Conditions

Mammals

Large mammals known or likely to occur on the preserve include elk, mule and black-tailed deer, black bear, cougar, bobcat, badger, beaver. Smaller mammals, such as northern flying squirrel, rabbits, Douglas squirrel, chipmunks, voles, shrew, and gophers are common and provide an important prey base to forest predators. Our query shows potential use of the preserve by 43 mammal species (see Appendix K).

A herd of Roosevelt elk uses the property and surrounding USFS lands as winter range and as transition habitat during migration (USFS, 2002). The Lake Creek riparian areas provide a secure travel route between the Cascade Crest and the lower elevations of the Metolius Basin. Lake Creek is a known calving area for elk, and the area adjacent to the Middle Fork in Section 17 shows evidence of heavy elk browsing. Elk probably use the property at least through early

summer (Turner, 2003). Black-tailed deer also use the property as transition habitat during migration (ODFW, 2002a; USFS, 2002).

Birds
Sixty-eight bird species have either been identified on the preserve, or are known local breeders in the area.

Amphibians
Our query shows potential use of the preserve by 5 amphibian species (see Appendix K).

Reptiles
Our query shows potential use of the preserve by 11 reptile species (see Appendix K).

Based on this assessment several general trends are evident regarding wildlife/habitat relationships on the Metolius Preserve.

- Habitat for species closely tied with open large tree structure of reference condition pine stands is inadequate on the Metolius Preserve.

- Species associated with large trees and late-successional mixed conifer conditions (e.g. pine marten, goshawk) have lost habitat since major timber harvests of last decade. Though this habitat condition was not prevalent under reference conditions.

- Species requiring open habitats (e.g. bluebirds, nighthawks, turkey, voles, ground squirrels, etc.) and others utilizing early-seral habitats have benefited from timber harvests during the last 10 years, particularly shelterwood and seed tree regeneration harvests. These harvests have significantly increased open habitats, particularly in Parcel 17.

- Snag resources for dead wood dependent species, particularly those that require large snags in moderate decay stages, are probably insufficient to maintain focal and key management species.

- Elk have probably benefited from timber harvests throughout the preserve. This management has likely increased grass and forb cover. In the riparian area, we surmise shrub cover has increased due to increased light from stand edge.

- Species that utilize stand edge and ecotones have likely benefited from recent timber harvests.

Listed Species

We have identified 11 State and/of Federal listed fish and wildlife species that are known to occur on forestland adjacent to the Metolius Preserve. Occurrence of these species on the ownership is unknown. The previous land owner had not located any nest sites for white-headed woodpecker, northern goshawk, or spotted owl (Williamson, 2003). Both white-headed and pileated woodpeckers have been spotted on the properties within last year.

***Table 7**. Listed Species on forestland adjacent to the Metolius Preserve*

Species	Genus/Species	Status – Federal (State)
	Mammals	
American Marten	*Martes americana*	(Vulnerable)
	Birds	
Northern Spotted Owl	*Strix occidentalis caurina*	Threatened (Threatened)
White-headed Woodpecker	*Picoides albolarvatus*	Species of Concern (Critical)
Northern Goshawk	*Accipiter gentilis*	Species of Concern (Critical)
Pileated Woodpecker	*Dryocopus pileatus*	(Vulnerable)
Pygmy nuthatch	*Sitta pygmaea*	(Vulnerable)
Olive-sided flycatcher	*Contopus cooperi*	Species of Concern (Vulnerable)
	Amphibians	
Cascade frog	*Rana cascadae*	Species of Concern (Vulnerable)
	Fish	
Sockeye salmon	*Oncorhynchus nerka*	Extirpated
Chinook salmon	*Oncorhynchus tshawytscha*	Locally Extirpated
Redband trout	*Oncorhynchus mykiss*	Species of Concern (Vulnerable)

Focal Management Species

A central objective for the Metolius Preserve is to restore forest conditions to habitat specifications for wildlife species closely tied to reference conditions. These "Focal Management Species[1]" (FMS) and their required habitat parameters are listed in Table 8. They include: **white-headed woodpecker and pygmy nuthatch.** The habitat desired by these species best represents both reference conditions on the preserve and a future desired condition. Current forest structure on the Metolius Preserve is not compatible with habitat requirements of northern spotted owl and great grey owl. We believe reference structure would not have supported either of these species. The northern spotted owl prefers large areas of dense mixed-conifer stands with high snag and

[1] Focal Management Species (FMS) are defined as those sensitive wildlife species that are closely tied to the desired forest structure/composition and are highly sensitive to alteration of this condition. Restoration based on FMS must consider both small scale (micro-stand), mid-scale (stand) and large-scale (landscape) components of habitat. Management for these species will encompass the requirements of those species also tied to that ~~structure/composition/function created.~~

down wood density. Great gray owls prefer stands bordering large open areas such as meadow or clear cuts.

Table 8. *Habitat Characteristics of Focal Management Species*

Focal Management Species	Habitat	Home Range	Habitat Parameter
White-headed Woodpecker	Open Mature Ponderosa Pine Forests	250-500 acres	Large diameter (>20" dbh) 2-3 class pine snags
			Open large tree stand structure
			Open understory (low % shrub cover)
Pygmy Nuthatch	Open Mature Ponderosa Pine Forests	N.A.	Large diameter (>20" dbh) 2-4 class pine snags
			Open large tree stand structure (<70% canopy)

White-Headed Woodpecker

In Central Oregon, the white-headed woodpecker is closely associated with large diameter open ponderosa pine forests. This species utilizes the classic mature pine stands that historically and still, to lesser extent, dominate the Metolius Basin landscape. Dixon (1995) found forty-three of 57 nests in the ponderosa pine forest-type in her study of white-headed woodpeckers on the Winema and Deschutes National Forests. The remaining nests were located in the mixed pine forest-type (4), dry mixed conifer forest-type (8). The Metolius Research Natural Area contains the highest density of this species in Oregon.

White-headed woodpecker breeding season begins in April-May and fledging occurs by mid July in Central Oregon. Home ranges vary from 250-500 acres. Diet varies seasonally; white-headed woodpeckers consume insects, mostly by bark gleaning in spring and summer, and pine seeds in fall and winter.

Specific habitat conditions needed for long-term health of white-headed woodpecker populations are suggested in Dixon (2002). Important parameters include ground cover, the size, species and condition of snags, spatial patterns of tree distribution, tree diameter distribution and stand size. Habitat Requirements are summarized below.

Snags

White-headed woodpeckers are moderate cavity excavators, and typically choose very large diameter ponderosa pine snags in stage 2-4 decay classes (Dixon 2002). They avoid punky snags. Dixon (1995) and Frenzel (1999) report average nest snag diameters of 25.4” and 26.4’ dbh in East Cascades pine forests. They nest low in snags (usually within 10” of base. Nest snags tend to be in small openings. The patchy distribution of trees in reference era pine forests created an abundance of this condition (see discussion of forest reference conditions). Since this species does not forage for insects in dead wood, snag densities required are typically less than those

required by other PNW woodpeckers. This species evolved in an environment depauperate in snags, compared to moister coniferous forests in the region, which may explain its diet.

Ground Cover

White-headed woodpeckers evolved in reference condition stands that had very low percent shrub cover, and down wood. This species may be suffering due to increased nest predation by small mammals. Frenzel (2004) attributes the low rate of nesting success throughout much of the Metolius Basin to nest parasitism by golden-mantled ground squirrel, Douglas squirrels, and chipmunks. Densities of chipmunks in ponderosa pine habitat in central Oregon have increased with shrub-cover, while densities of golden-mantled ground squirrels increased with more down wood (Smith 2002). Shrub cover and down wood have increased markedly in the ponderosa pine habitat in central Oregon with continued fire suppression (Marshall 1997). Timber harvests that retained high slash and cull wood have also increased habitat for these small mammals. In the Metolius Basin, although white-headed woodpecker populations are high, the only apparent source habitats for this species are on the Metolius Research Natural Area. These stands have been underburned to reduce shrub and small tree cover.

We suspect that most of the Metolius Preserve is currently marginal habitat for white-headed woodpeckers for the following reasons: **1)** Shrub density is too high. **2)** Stand density is too high and tree distribution homogenous. **3)** Average stand diameter is too small. **4)** Snag density among desirable species, decay stage and size is too low. Most nest snags used by this species in Central Oregon (90 % in the Metolius Basin) are in ponderosa pine. Of the 2.03 snags/acre, averaged over the preserve, only .43 snags/acre were ponderosa pine 20" + dbh. We calculated a density of .13 snags/acre in ponderosa pine 24" + dbh (the approximate average nest snag diameter recorded by Dixon (1995) and Frenzel (1999). Research has not provided optimal snag densities for white-headed woodpecker. However, based on reference stand estimates from Harrod et al. (1998), Agee (2000) and Korol et al. (2002) which range from 1-2 snags/acre >19" dbh, 2/acre with average size of 30" dbh, and 0.4 to 0.7/acre > 20", respectively, we surmise current snag resources are insufficient to meet habitat needs of this species.

Pygmy Nuthatch

The pygmy nuthatch is a cavity nesting bird closely tied to mature ponderosa pine forests containing large pine snags. This species is regarded as one of the best indicator species for overall health of bird communities in mature ponderosa pine forests (Szaro and Balda 1982). The pygmy nuthatch is a cooperative breeder, typically one third of all breeding pairs have one to three male helpers, usually progeny or other relatives. Nests are primarily found in dead pines and, to a lesser extent, in dead sections of live trees. Cavities are often situated under or near existing broken off branches. Pygmy nuthatches are both primary and secondary cavity nesters, though they usually excavate their own holes. Cavities are used for nesting and roosting during the breeding season and communal roosting by family groups during winter. The pygmy nuthatch relies heavily on pine seeds during the non-breeding season in addition to bark dwelling insects. During spring and summer months, feeding shifts to insects throughout tree, though it seems to prefer foraging in dense tree foliage. Existing information suggests that pygmy nuthatches have very limited movement patterns and this lack of movement may make them vulnerable to the effects of habitat fragmentation.

Little research has been conducted in Oregon to quantify essential habitat parameters. Studies from other parts of the west suggest the most important habitat components include: 1) Availability of large diameter snags in a variety of decay classes. 2) Abundance of large diameter ponderosa pine trees.

Snag management levels for pygmy nuthatch are scarce in the literature. Frenzel (unpublished data) provides the only available data from Oregon ponderosa pine stands to guide snag management. Average snag diameter used by pygmy nuthatch in this Central Oregon study area was 24" dbh. Pygmy nuthatches require large snag, to accommodate communal roosting. Stands on the Metolius Preserve currently lack this structure. This species may benefit from large hollow pine trees. Large numbers of nuthatches (at least 100 in one study) have been documented using this structural feature. This species appears to prefer snags with moderate to hard decay stages. The only literature providing specific snag density levels (USDA 1979), recommends 1.08 hard snags/acre 15"+ dbh. The average density of ponderosa pine snags on the preserve in this size and decay stage was .01 snags/acre. All parcels failed to provide this type of snag in inadequate numbers.

Other Key Management Species

Flammulated Owl
Flammulated owls are closely associated with open mature ponderosa pine/and mixed conifer forests with pine components. Goggans (1986) described nesting habitat in eastern Oregon as stands of ponderosa pine/Douglas-fir, 30-50 cm DBH, with less than 50% canopy closure. They are obligate secondary cavity nesters, using cavities created by pileated woodpeckers, flickers and sapsuckers. Flammulated owls prefer large ponderosa pine snags and will use other species. Bull et al. (1990) and Goggans (1986) report average snag diameters of 28" and 22" dbh, respectively. Flammulated owls prefer open forest with grass understories and edge for foraging, and dense tree thickets (as would be found in regenerating pine cohorts after scattered beetle mortality) for roosting and calling. Open stands with heavy shrub cover are avoided. This species seems well adapted to reference stand conditions on the Metolius Preserve.

Northern Goshawk
Historical use of reference condition ponderosa pine stands by Northern goshawks is unknown but based on the habitat features they prefer (see below), we suspect densities were higher in the Mixed Conifer Types where stand densities were higher. The nesting home range of goshawks contains three components: the nest area, the post-fledgling family area, and the foraging area, each with its individual characteristics and management requirements. The size and shape of nest areas depend on topography, and on the availability of dense patches of large trees ranging in size from 8 to 12 ha. Surrounding the nest area is the PFA and foraging area mosaic. The PFA is a 170-ha (range= 120-240 ha) mosaic of large trees, large snags, mid-aged forests, small openings with an herbaceous understory, and large, downed logs. The foraging area is 2,200 ha (range = 2000-2400 ha). Intraspecific nest spacing tends to be regular clumping, and occurs near meadows and riparian systems, with an average distance between nests in Oregon of 5.6 km. Nests are generally constructed in the largest trees of dense, mature stands with high canopy closure (60-95 percent) and sparse groundcover, near the bottom of moderate slopes, and near water. Occasionally, they will nest in relatively open stands <10 percent canopy coverage. Nest height ranges from 2.5-43 meters and may be used in successive years.

Roosevelt Elk
Roosevelt elk are known to use the preserve. The area between the Middle and North Fork Lake Creek appear to be used for calving. These areas contain abundant grass, with good forage, while riparian areas provide cool moist conditions and excellent hiding cover due to dense shrub and trees and large down woody debris. Portions of Stand 1714 have dense vine maple cover. Management should maintain high shrub cover and down wood in these areas. Abundant grass cover (blue wildrye), particular in Stand 1720 should be maintained by keeping overstory relatively open.

FOREST MANAGEMENT SYNTHESIS AND RECOMMENDATIONS

Management Goals

The core forest management goals for the Metolius Preserve are summarized below:

- To restore historic anadromous fish populations through habitat improvement and protection.

- To restore and maintain riparian and upland habitats in a condition that supports native wildlife populations associated with reference forest conditions.

- To reduce risk of catastrophic forest fire by realigning current with reference forest conditions and disturbance regimes.

- To integrate management with USFS plans for surrounding lands to achieve landscape-scale objectives.

- To restore and maintain rare and listed plant populations.

- To provide for low-impact recreational use where consistent with natural resource protection and restoration goals.

- To provide for public interpretation, educational and research opportunities focused on the unique fishery and forest resources found on, and adjacent to, the preserve.

- To achieve above goals with limited financial outlays by encouraging self-sustaining management approaches.

Desired Future Conditions

Methods and Approach

To achieve these goals we developed a series of stand and ownership level desired future conditions (DFC) for the preserve. The DFC analysis synthesized and integrated both broadly

defined goals and more specific management objectives. DFC were not intended to be a static, narrowly defined set of targets. Forest ecosystems are dynamic; parameters change at various spatial and temporal scales in both predictable and irregular/unpredictable patterns. At the same time, DFC serve as targets guiding management, and need to be well-defined and tangible. We sought a balance that provided enough specificity to guide restoration efforts, while addressing forest ecosystem dynamics. To accomplish this we framed DFC as a range of forest structure and compositional conditions that may occur at spatial and temporal scales approximately consistent with the reference era[1]. Use of reference forest conditions as a foundation and template for future stand structure and composition is widely used by restoration practitioners. The reference condition target is an interpretation of the vegetation community that evolved under past disturbance regimes, and is well adapted to the current soils and climatic conditions of the area. This reference condition also provides a broad description of the necessary habitat conditions for focal wildlife management species. We can assume the reference period provides adequate habitat for these guilds, as they evolved under these conditions over the last several thousand years[2].

The use of reference conditions as a management target is generally consistent with core management goals of restoring habitat of focal and key management species, creating fire-resilient forest structure, while realigning disturbance regimes to those that will sustain desired vegetation. However, it is important to recognize potential tradeoffs and limitations of this approach. Habitat restoration is often a "zero-sum" process; some target species gain while others lose. For example, some of the treatments required to move plant communities back to reference conditions may detriment wildlife species that have benefited from activities such as timber harvesting and fire suppression[3]. Our approach, to issues of habitat gain-loss, is to manage structure for those species associated with the reference condition forest, except in limited situations where benefits to sensitive species can be achieved with minimal risk and change.

Prior to ownership by DBLT stand density in most stands was maintained at levels that balanced need to maximize stand growth, while reducing fire risk. Current objectives place restoration of mature forest structure ahead of wood production and hence require a different management strategy. The silvicultural strategy is based on three central concepts:

1) Thinning stands from below to variable densities, including very low Stand Density Index (SDI) to maximize individual tree growth and manipulate species composition to desired early-seral species.

2) Restoring group-wise multi-cohort distribution across the ownership.

3) Reducing surface fuels, shrub cover, and understory fir regeneration through prescribed burning and mechanical brushing.

[1] Reference era and condition refer to general time period and forest structure and composition just prior to major natural resource manipulation during Euro-American settlement.
[2] Evidence suggests the current ponderosa pine forest type first emerged during the early Holocene (9,400-7,800 years ago), replacing steppe communities that dominated during the preceding glacial period.
[3] For example, fire suppression within dry mixed conifer types has increased habitat for pileated woodpecker, at the ~~expense of white-headed woodpecker. Restorative treatments will benefit the later at the expense of the form~~er.

MONITORING PLAN

A monitoring plan is essential to gauge progress toward meeting management objectives. It provides the feedback necessary for adaptive management, whereby restorative treatments and techniques can be modified in response to undesirable or unintended treatment effects (e.g. inadequate consumption of surface fuels during prescribed burning) or new resource issues (e.g. discovery of new noxious weed). We define an effective monitoring plan as one whose protocols are simple to implement while providing the necessary data to assess well-defined indices of resource change. Complex monitoring systems are appropriate under certain conditions where research is a key focus. However, highly detailed monitoring plans are often ineffective; measurement and data analysis can be time consuming and expensive to complete. We have found that most of the key management questions can be answered with a relatively simple monitoring design. This plan includes two components: 1) Post Treatment Effectiveness Monitoring, and 2) Long-Term Management Monitoring.

Glossary to Terms

Age Class: Interval of years, commonly 20, into which trees are grouped for management, for example 1-20 years, 21-40 years.
Anadromous: Migrating from the sea to fresh water to spawn.
Basal Area (BA): The area of the cross section of a tree stem near its base, generally at breast height (4.5 ft. from ground level). Often used as a measurement of how much of a site is occupied by trees and expressed as the collective basal area of trees on a per-acre basis.
Best Management Practices (BMP): Application of the best available demonstrated control, technology, processes, measures and operating methods that are socially, economically, and technically feasible for controlling soil loss or improving water quality.
Big Game: Those species of large mammals normally managed as a sport hunting resource, such as elk, deer and pronghorn.
Black Bark Pine: An informal term which describes ponderosa pine trees, which are characteristically pole sized timber or middle aged to mature forest, with tree bark which is darker in color. These trees do not yet display any orange or yellow bark coloration.
Board Foot: Measure of an amount of timber equivalent to a piece 12"x12"x1".
Broadcast Burn: A controlled fire on a designated area within well-defined boundaries for reduction of fuel hazard, as a silvicultural treatment, or both.
Buffer Strip: A water quality protection measure that leaves a band of area on both sides of stream with the soil, ground cover and vegetation undisturbed. It serves to keep logging debris out of the stream, filter sediments and pollutants from runoff, prevent temperature increases by shading the stream, and stabilization of the streambanks. A practice generally recommended for perennial streams. Guidelines to estimate the width of the buffer strip usually include site-specific analysis, including slope steepness, length, and ground cover percent.
Burn Plan: An operating plan specifying certain events that will take place in order to apply fire to wildland fuels to meet planned (silvicultural, wildlife, fuel management) objectives. The plan describes what, where, when and who will accomplish the objectives and under what conditions.
Canopy Cover: The more or less continuous cover of branches and foliage formed collectively by the crown of adjacent trees and other woody growth.
Nesters: Wildlife species that utilize tree cavities. Primary cavity nesters excavate their own hole. Secondary cavity nesters use natural cavities or cavities created by primary cavity nesters.

Clearcut: Removal of the entire standing crop of trees from an area at one time. Also the opening that results from clearcutting.
Climax Species: Plant species occurring in a relatively stable community.
Clumpiness: The occurrence of trees in groups.
Commercial Thinning: A harvest, for the purpose of maintaining desirable growth rates on the individual trees that would remain by improving the spacing between trees. Health and vigor are improved by reducing crowding and removing inferior and diseased trees.
Condition Class: A function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure.
Crown bulk density: A measure of canopy fuels used in fire behavior modeling applications.
Cultural Resources: The physical remains (artifacts, ruins, burial mounds, carvings, etc.), which represent former human cultures.
Cumulative Effects: The impact on the environment, which results from the incremental effect of the proposed action when added to other past, present, and reasonably foreseeable future actions.
DBH: Diameter at breast height. The diameter of a tree measured 4 feet, 6 inches from ground level.
Deciduous: Shedding or losing foliage at the end of the growing season: (i.e. *deciduous trees).*
Desired Future Condition: The preferred condition of the landscape and resources (soil, air, water, vegetation, wildlife).
Disturbance regimes: A set of descriptor that define events, such as forest fire or insect infestations, that alter the structure, composition, or functions of an ecosystem.
Diversity: "The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan" [36 CFR 219.3].
Duff: The layer of partly decayed organic matter (forest litter) on the forest floor. This layer may vary from almost non-existent to several inches thick.
Dwarf Mistletoe: Mistletoes are parasitic plants that cause injury to their woody plant hosts. Dwarf mistletoes live on conifers only, while true mistletoes occur on conifer and hardwood trees and shrubs. Dwarf mistletoes can seriously retard growth and sometimes result in death of the host tree.
Ecotone: A transitional area between two adjacent ecological communities.
Endangered Species: Plant or animal species identified by the Secretary of Interior as endangered in accordance with the Endangered Species Act of 1973.
Erosion: The processes whereby earthy or rocky material is worn away, loosened, dissolved and removed from any part of the earth's surface.
Evenage Management: The application of a combination of actions that result in the creation of stands, in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and therefore tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration, in a particular stand, is obtained during a short period at or near the time when a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.
Fault Scarp: A steep slope or cliff formed directly by movement along a fault and representing the exposed surface of the fault before modification by erosion and weathering
Filter Strip: A water quality protection measure that leaves a band of area on both sides of a stream with minimal disturbance to soil and ground cover. It serves mainly to filter sediment and

pollutants from runoff before entering a non-perennial stream. Removal of trees is permitted within the filter strip, with harvest method limitations to protect the soil and ground cover (i.e., no mechanical entrance, directional felling). A practice generally recommended for intermittent and ephemeral streams.

Fire Condition Class: A function of the degree of departure from historical fire regimes, resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure.

Forest Health: A condition wherein a forest has the capacity across the landscape for renewal, recovery from a wide range of disturbances, and retention of its ecological resiliency, while meeting current and future needs of people for desired levels of values, uses, products and services.

Forest Structure: The horizontal and vertical arrangement of trees and tree sizes.

Forb: A broad-leaf herbaceous plant; for example, western yarrow, mountain dandelion and milkvetch.

Forage: Specifically, all plants available to livestock or game animals, which are used for grazing or harvested for feeding.

Fuels: Anything within the forest that will burn, usually live and dead woody vegetation, e.g., grass, shrubs, trees.

Fuel Treatment: The rearrangement or disposal of fuels to reduce the fire hazard. Fuels are defined as both living and dead vegetative materials consumable by fire.

Geomorphic processes: Pertaining to those processes that affect the form or shape of the surface of the earth.

Habitat Type: A habitat type is the basis of a forest ecosystem classification system. It is an aggregation of all land areas potentially capable of producing similar plant communities at climax. Habitat types are usually named for the most shade tolerant tree species that will grow on the site and an understory plant that is represented with a high degree of constancy.

Hiding Cover: Vegetation that will hide 90 percent of an elk from the view of a human at a distance of 200 feet or less. The distance at which the animal is essentially hidden is called a sight distance.

Historic Conditions: Define the range of vegetation conditions, both structurally and compositionally, at different spatial scales (i.e. fine scale vs. landscape scale) during the period prior to major Euro-settlement. We use 1850 as a reference date because early settler accounts provide the best assessment of vegetation prior to major changes.

Indicator Species: A wildlife species whose presence in a certain location or situation at a given population level indicates a particular environmental condition. Population changes are believed to indicate effects of management activities on a number of other wildlife species.

Ladder Fuels: The fuel types in the form of tree branches (live or dead) or other vegetative buildup on live or standing dead trees, which create the potential of elevating ground fire in a forest understory, up into the crowns of trees.

Listed Species: Any species, which occurs on a state or Federal (as specified in context) threatened or endangered species list.

Litter: This is one component of ground cover, consisting of dead plant materials. Essentially the freshly fallen or slightly decomposed vegetable material, mainly foliate or leaf fall, but also bark fragments, flowers and fruits.

MBF: 1,000 board feet of timber—roughly equivalent to 1-inch flooring 20 feet by 50 feet. Another way of representing the meaning of a certain volume of timber is that it takes roughly 20,000 board feet to build a 3-bedroom house of 1,800 square feet.

Mesic (Habitats): Forests or other areas, which are more moist and cool. Mesic habitats are generally located along drainages, at the base of slopes or on northerly exposures.
Mistletoe: See dwarf mistletoe.
Mitigation: Measures designed to counteract environmental impacts or to make impacts less severe.
Neotropical Migratory Birds: Species that migrate north each spring to breeding grounds in the United States and Canada, then fly south to spend the bulk of the year in Mexico, Central or South America. Many of the common song birds are neotropical birds.
Net Volume in Board Feet: The gross board foot volume of trees less deductions for rot and other defect affecting use for lumber. Volume is computed for the central stem from a 1-foot stump to a specified top diameter.
Old Growth: Forest sites distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development, which typically differ from earlier stages in a variety of characteristics that, including tree size, accumulations of large dead woody material, number on canopy layers, and species composition and ecosystem function.
Outwash plain: Glacial outwash is the deposit of sand, silt, and gravel formed below a glacier by meltwater streams and rivers. An outwash plain is an extensive, relatively flat area of such deposits.
Overstory: The uppermost canopy (tree tops) in a stand of trees.
Percent Slope (Gradient): A measurement of the steepness of a slope determined by dividing the vertical increase by the horizontal distance traveled. Therefore 100 percent slope is equal to a 45 degree rise and a 40 percent slope is equal to a 22 degree rise. The latter is the cut-off point where the skyline logging system is required in order to harvest timber.
Permeability: A measure of the rate at which water can percolate through soil.
(Potential Vegetation) Plant Associations~ The distinctive combination of trees, shrubs, and herbs occurring in a theoretical terminal or climax community, identified by indicator species.
Precommercial Thinning (PCT): Thinning of small diameter trees with little or no commercial value. The trees that are felled are not utilized. The thinning is done at a cost to improve forest health, and/or to increase the radial growth of the residual (remaining) trees in the stand. The thinning is considered an investment, which is charged against future stand values.
Prescribed Fire: The intentional application of fire to wildland fuels in either their natural or modified state under such conditions as to allow the fire to be confined to a predetermined area and, at the same time, to produce the intensity of heat and rate of spread required to further certain planned objectives of silviculture, wildlife management, etc.
Rainshadow effect: zone in the lee of a mountain range that receives less rainfall than the windward side.
Reforestation: The natural or artificial restocking of an area usually to produce timber and other wood products, but also to protect watersheds, prevent soil erosion, and improve wildlife, recreation, and other natural resources. Natural reforestation includes site preparation to reduce competing vegetation and provide a mineral seed bed for seed provided by seed trees. Artificial reforestation is the planting of seedlings, cuttings or seeds by hand or mechanical means and may include site preparation.
Reference Conditions: The range of vegetation conditions, both structurally and compositionally, at different spatial scales (i.e. fine scale vs. landscape scale) during the period prior to major Euro-settlement. We use 1850 as a reference date because early settler accounts provide the best assessment of vegetation prior to major changes.
Refugia: Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range.

Regeneration: This term can be used in two ways, the actual seedlings and saplings existing in a stand, or the act of establishing the young trees.
Riparian Area: Land areas, which are directly influenced by water. They usually have visible vegetative or physical characteristics showing water influence. Streamsides, lake borders, or marshes are typical riparian areas.
Riparian Management Zone: A water quality protection measure that leaves a band of area on both sides of a stream with the soil, ground cover and vegetation undisturbed. It serves to keep logging debris out of the stream, filter sediments and pollutants from runoff, prevent temperature increases by shading the stream, and stabilization of the streambanks.
Road Density: The number of miles of road per square mile.
Road Decommissioning: Eliminating an unneeded road and returning the land it occupied to production or another use. The road is removed from the forest transportation system. When needed for resource protection or to adhere to the Forest Plan, additional measures such as scarification, seeding or possibly elimination of all roadway features will be done.
Sawtimber: Trees that are 9 inches DBH or larger and can be made into lumber.
Sediment: Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.
Seed tree: A tree selected as a natural seed source within a shelterwood or seed tree harvest cut; sometimes also reserved for seed collection.
Seral: a transitional stage in plant succession. Environmental conditions, species, or biotic communities may be described as seral in contrast to climax.
Seral Species: Any plant or animal that will be replaced over time through forest succession.
Seral Stage: Any plant community with plant composition that is changing in a predictable way; for example, an aspen community changing to a coniferous forest community.
Shelterwood: An even-aged silvicultural harvest and regeneration system that gradually removes most or all trees in a series of partial cuttings, which resemble heavy thinning. Regeneration establishes under the protection of partial canopy cover
Short-Term Effects: Those effects, which will not be significant beyond the planning horizon of 50 years.
Silviculture: The art and science of managing a forest ecosystem to achieve specified management objectives.
Silvicultural System: "A management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the fellings that remove the mature crop and provide for regeneration and according to the type of forest thereby produced." [36 CFR 219.3]
Slash: Debris left after logging, pruning, thinning or brush cutting, and large accumulations of debris after wind or fire damage. Slash includes logs, bark, branches, and stumps.
Snag: A standing dead tree larger than 6 inches in diameter at breast height.
Snag Recruitment: Reservation of suitable live trees near death for replacement of snags in the future or killing trees to create new snags.
Soil Productivity: The capacity of a soil, in its normal environment, to produce a specific plant or sequence of plants under a specific system of management. **Species richness:** The total number of species in an area.
Stand: A community of trees possessing sufficient uniformity as regards composition, constitution, age, spatial arrangement, or condition, to be distinguishable from adjacent communities, so forming a silvicultural management entity.

Stocking: Refers to the basal area or number of trees per acre in a stand. Stocking levels can be prescribed to meet management objectives, such as improving forage habitat for wildlife, or improving growth rates of trees.
Successional Stage: A recognizable stage that a plant community passes through during its development from seral to climax vegetation.
Suppression Mortality: Tree death caused be excessive competition with adjacent stems.
Thermal Cover: Vegetative cover providing protection for animals from heat and cold; normally used to describe habitat requirements for elk and deer.
Thinning: An intermediate cut made in the favored species to accelerate diameter growth and to improve the form of the remaining trees without permanently breaking the canopy. A thinning can be either a commercial or precommercial thinning depending upon the tree size (product) and economic value, if any. Precommercial thinning costs are usually charged against future stand value.
Threatened Species: Those plant or animal species identified by the Secretary of Interior as threatened in accordance with the Endangered Species Act of 1973.
Tree Retention Levels: Stocking remaining after a stand treatment.
Understory: The trees occupying the lower level of a stand that has at least two size and age classes. The understory lies beneath the overstory.
Uneven-Aged Management: The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is usually regulated by specifying the number or portion of trees to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection, group selection, and irregular shelterwood.
Vegetative Structural Stage: A generalized description of the forest growth and aging stages based on the majority of the trees in the specific diameter distribution of the stand.
Watershed: The entire area that contributes water to a drainage or stream.
Western Spruce Budworm: The western spruce budworm has caused significant defoliation, growth loss and mortality. Host trees for this insect include white fir, corkbark fir, Douglas-fir and spruce.
Wetlands: Any area that is more or less regularly wet or flooded. Where the water table stands at or above the land surface for at least part of the year.
Wildfire: Any fire on wildlands other than one intentionally set for management purposes and confined to a predetermined area.
Wildlife: All undomesticated mammals, birds, reptiles and amphibians living in a natural environment, including both game species and nongame species. Animals or their progeny which once were domesticated but escaped captivity and are running wild (i.e., feral animals), such as horses, burros and hogs are not considered wildlife.
Windthrow: Trees blown over by wind.